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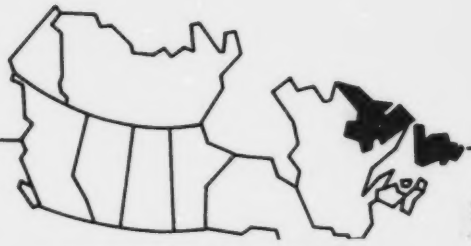
North Pond : Demonstrations of reforestation research results

J. Richardson, J.P. Hall and R.S. van Nostrand



Information Report N-X-227
Newfoundland Forest Research Centre

Environment Canada
Environnement Canada

0016084C VOL ISS 227 1984
EXC # 001
SD 391 C363
INFORMATION REPORT (NEWFOUNDLAND
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NORTH POND: DEMONSTRATIONS OF REFORESTATION RESEARCH RESULTS

by J. Richardson, J. Peter Hall and R.S. van Nostrand

INFORMATION REPORT N-X-227
1984

NEWFOUNDLAND FOREST RESEARCH CENTRE
CANADIAN FORESTRY SERVICE
AGRICULTURE CANADA

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ISSN NO. 0704-7657
CAT. NO. Fo46-15/227E
ISBN NO. 0-662-13666-7

Copies of this report are available from:

Newfoundland Forest Research Centre
Canadian Forestry Service
Box 6028, St. John's, Newfoundland
Canada A1C 5X8

Telephone No. 709-772-4817

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ACKNOWLEDGEMENTS

The authors of this volume, who are currently responsible for the studies which were active at North Pond at the time of writing, owe a great debt to their colleagues and others whose efforts helped to establish and maintain the experimental area. In particular, we acknowledge the inspiration, foresight and dedication of W.C. Wilton who was largely responsible for initiating the whole North Pond concept, having selected the area, and initiated most of the original studies. Other researchers who have been involved with North Pond studies include E.W. Howard, M.A.K. Khalil and J. Nicholson.

Since 1962 when North Pond was established, many research technicians, summer students and casual employees have contributed greatly by their work to the creation of what is there now. For several of the students North Pond proved an important formative experience, and they have gone on to achieve positions of prominence in the forestry profession in Newfoundland. Of the technicians, particular mention should be made of J.P. Bouzane, V. Chaffey, W.J. Curran, C.H. Evans, D.A. Rowe and P.T. Tricco whose skill and dedication has been of critical importance over the years.

NORTH POND: DEMONSTRATIONS OF REFORESTATION RESEARCH RESULTS

by

J. Richardson, J. Peter Hall and R.S. van Nostrand

INTRODUCTION

Wildfire has played a major role in determining the present structure and composition of forest stands in central Newfoundland, or on some sites in causing the present absence of forest stands. Studies of natural regeneration following wildfire and trials of techniques to reforest burned sites have always been an important aspect of forestry research in Newfoundland. Amongst the earliest research projects of the then Federal Department of Resources and Development, Forestry Branch, following its arrival in this Province in 1950, were a study of natural regeneration on a series of recent major wildfires in the east-central part of the Island, and a trial of several direct seeding methods using black spruce on a freshly burned cutover (Dickson 1952).

In 1961, forest fires were unusually numerous and extensive in Newfoundland. In the aftermath of this bad fire year, renewed emphasis was placed on reforestation research. A large section of one of the burned areas was set aside specifically for burned-land reforestation research. This area which borders on North Pond in east-central Newfoundland, is known as the North Pond Forest Experimental Area, or more briefly, 'North Pond'.

Over the years since then, many experiments and studies have been established at North Pond encompassing the fields of natural regeneration, direct seeding, site preparation, planting, species trials and tree improvement amongst others. A small-scale forest nursery, operated in the experimental area from 1965 to 1970, produced much of the planting stock used in the trials. Most of the reforestation trials were followed closely for five years, measured and analysed, and the results published. However, the seeded or planted material has continued to grow and, together with the tree improvement plantations and species trials, which are still monitored regularly, constitutes a valuable collection of demonstrations of techniques, species and provenances for reforestation.

Information about the North Pond studies is scattered through some 50 publications, as well as unpublished reports and other documents. To enhance the demonstration value of the area as a whole, a single source of information would be very valuable. This publication provides that. It includes the results of recent remeasurements of most of the older trials and presents the first measurements from a series of demonstration plantations established in the late 1960's which had never been examined in detail. Introductory chapters give general background information relative to the experimental area.

The Environment

The North Pond Forest Experiment Area (48°42'N, 54°30-38'W) is located in the Mint Brook Valley in east-central Newfoundland about 27 km south of Gander (Figure 1). It occupies an area of 3 110 ha (3.2 km x 9.7 km).

The east-central region of Newfoundland has a climate which receives less oceanic influence than other parts of insular Newfoundland: temperature extremes are greater and precipitation is less. Representative climatological data for Gander International Airport, the station with long-term records nearest to North Pond, are as follows:

Mean annual temperature	4°C
Mean January temperature	-6°C
Mean July temperature	16°C
Extreme minimum temperature	-27°C
Extreme maximum temperature	36°C
Mean number of days with frost	187
Mean degree days above 5°C	1265
Mean length of growing season (mean daily temperature above 5°C)	163 days (May 10 - Oct 20)
Mean annual total precipitation	1078 mm
Mean annual rainfall	719 mm
Mean annual snowfall	355 cm
Maximum rainfall in 24 hours	98 mm
Mean total precipitation May - Sept	401 mm
Mean number days with rainfall May - September	71
Mean January windspeed	26 km/h
Mean July windspeed	18 km/h
Prevailing wind direction	W/SW

A seasonal meteorological station was maintained at North Pond from May to October in the years 1964 to 1969. Mean monthly temperatures recorded were generally the same as at Gander, but the daily temperature range at North Pond was greater. The most significant aspect of this difference is that freezing temperatures occurred more frequently at

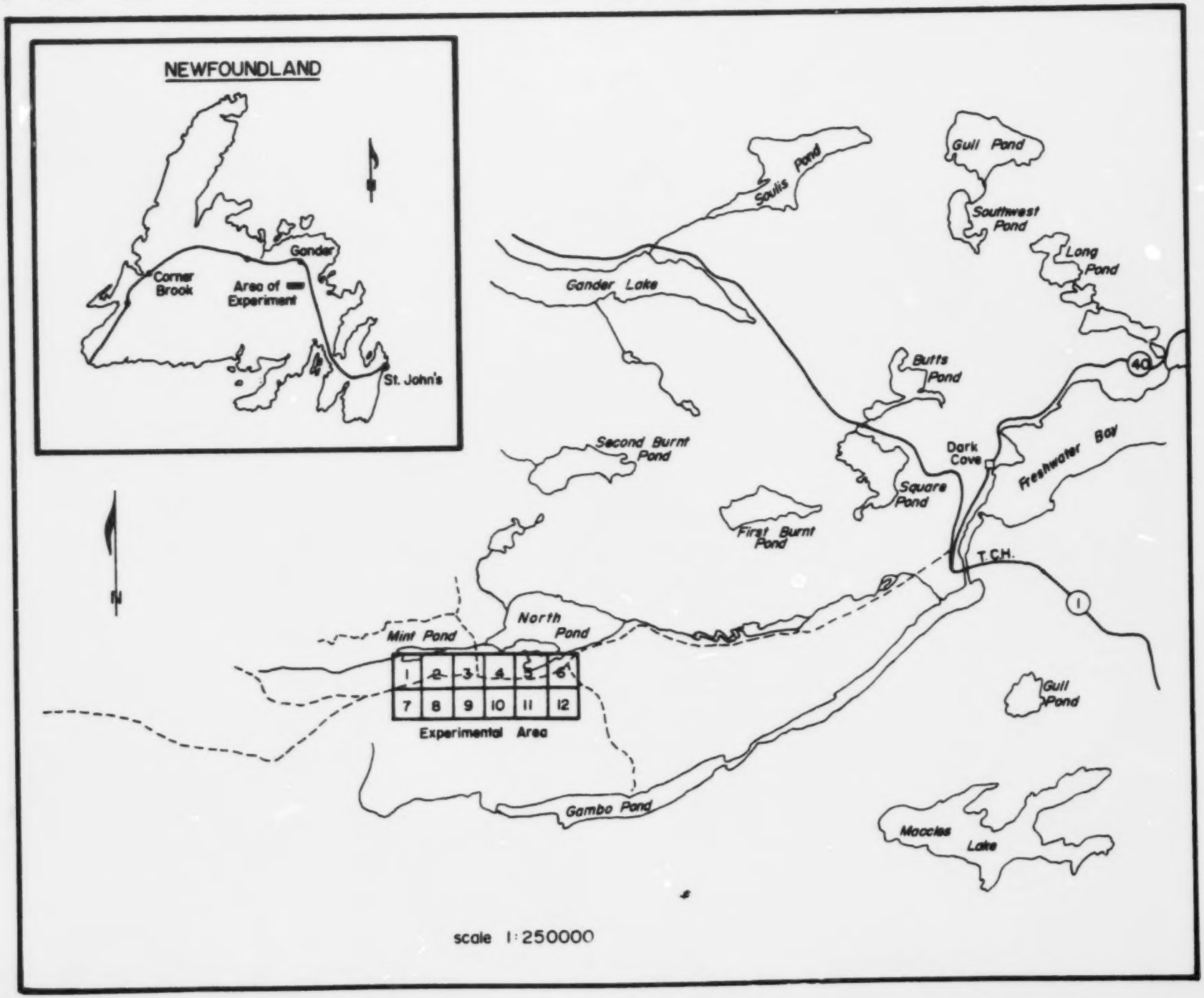


Figure 1: Location of North Pond.

North Pond (41 days June - September 1964-69) than at Gander (14 days). This is perhaps due to the North Pond station's location in a valley compared to Gander Airport's plateau situation.

The experimental area lies on the south side of the shallow Mint Brook Valley, extending in elevation from North Pond at 85 m above sea level to a bog- and barren-covered height of land at 215 m. The slope is gentle and fairly regular. It is interrupted only by a broad basin-shaped depression in the eastern part of the area where several brooks join to flow northward into North Pond.

Bedrock underlying most of the experimental area is of sedimentary origin dating from the Ordovician and Silurian periods. However, the bedrock is mostly overlain by a deep layer of glacial till. The boulders contained in this till are chiefly of schistose or slate material in the western half of the area; in the east granite boulders prevail. This difference appears to have contributed to a difference in the productivity of soils derived from the till on the two halves of the area: productivity is greater in the west generally than in the east.

Soils derived from the till are mostly stony sandy loams. In some places rocks and stones predominate at the surface, and only a few pockets of soil can be found. This situation was much more prevalent shortly after the fire when surface organic matter had been removed by the fire. The process of revegetation has since recovered most of the bouldery surface.

Areas of organic soils are found on the higher flat ground, in the central depression, and in scattered pockets elsewhere. These are either nutrient-poor Sphagnum bogs or alder swamps with muck soils which are more nutrient-rich.

Soil moisture varies from dry in a few areas of water-deposited sand to wet in the peatland and alder swamp sites. Most of the mineral soils, however, are fresh to moist.

Over most of the rocky till soils on the slopes, the organic layer is thin, 5 cm or less. On flatter ground the organic layer is deeper, up to 30 cm or more, with kalmia mounds through which the organic depth may be 40-50 cm. On peatland sites, peat depths over 150 cm have been measured.

History

Over the years, the area has been burned repeatedly. Examination of trees remaining from recent fires indicates that they originated after fires in 1865 or 1886. A strip cruise carried out in 1934 showed that black spruce was the major softwood component of the forest at that time. However, balsam fir predominated at the west end and in

patches farther east. Timber volumes over the western half of the area ranged from 70 to 180 m^3/ha. In the eastern half of the area and in the central depression, volumes were much lower, generally less than 45 m^3/ha. Mixed with the spruce and fir in the western half of the area and at the extreme east end was a considerable proportion of hardwoods, mainly white birch (Betula papyrifera Marsh.) with some trembling aspen (Populus tremuloides Michx). Also on the western half of the area were scattered white pine (Pinus strobus L.). Pine was the chief raw material for a large sawmill which operated near the mouth of Mint Brook 20 km east of the area in the early part of the century.

In 1941, fire swept the eastern part of the experimental area (Figure 2). A strip was burned about 1 to 2 km wide running in a south-westerly direction from the shore of North Pond. About 1945 a road was constructed into the burned area from Gambo 25 km to the east and some of the fire-killed stands were salvaged for pulpwood.

Ten years after the 1941 fire, a regeneration survey was conducted over the burned area (Dickson 1952). This survey considered 'regeneration success' to be indicated by the presence of seedlings on at least 8 out of 20 milacre quadrats in a reproduction plot. On this basis, regeneration success for black spruce was 83 percent on the best sites which occupied 10 percent of the area, 44 percent on the 44 percent of the area classed as intermediate site, but only 10 percent on the poor sites which occupied 46 percent of the area. Lack of stocking on the poor sites was attributed to the presence of a thick peat-like fibrous layer, and abundance of ericaceous shrubs, and the lack of seed supply (Dickson and Nickerson 1958).

Beginning about 1954 the stands west of the 1941 fire were harvested for pulpwood, moving gradually westwards. After cutting, only scattered large white pine, white birch and aspen, and occasional patches of stunted black spruce remained.

Fire again swept the area in August 1961, burning the entire cutover as well as half the strip which was burned in 1941. Within the boundaries of the experimental area, standing green timber remained only in the southeastern corner.

The establishment of North Pond was prompted by this 1961 fire (Wilton 1962). The boundaries of the experimental area were surveyed in 1962-63, an intensive regeneration survey was conducted of the burned portion of the area in 1964-65, and a wide variety of experiments and studies were established, chiefly from 1963 to 1968. All the seeding and planting studies described in this volume are located in the burned area, mostly the area burned in 1961 though some are on the 1941 burned area or the strip which was burned in both 1941 and 1961 fires.

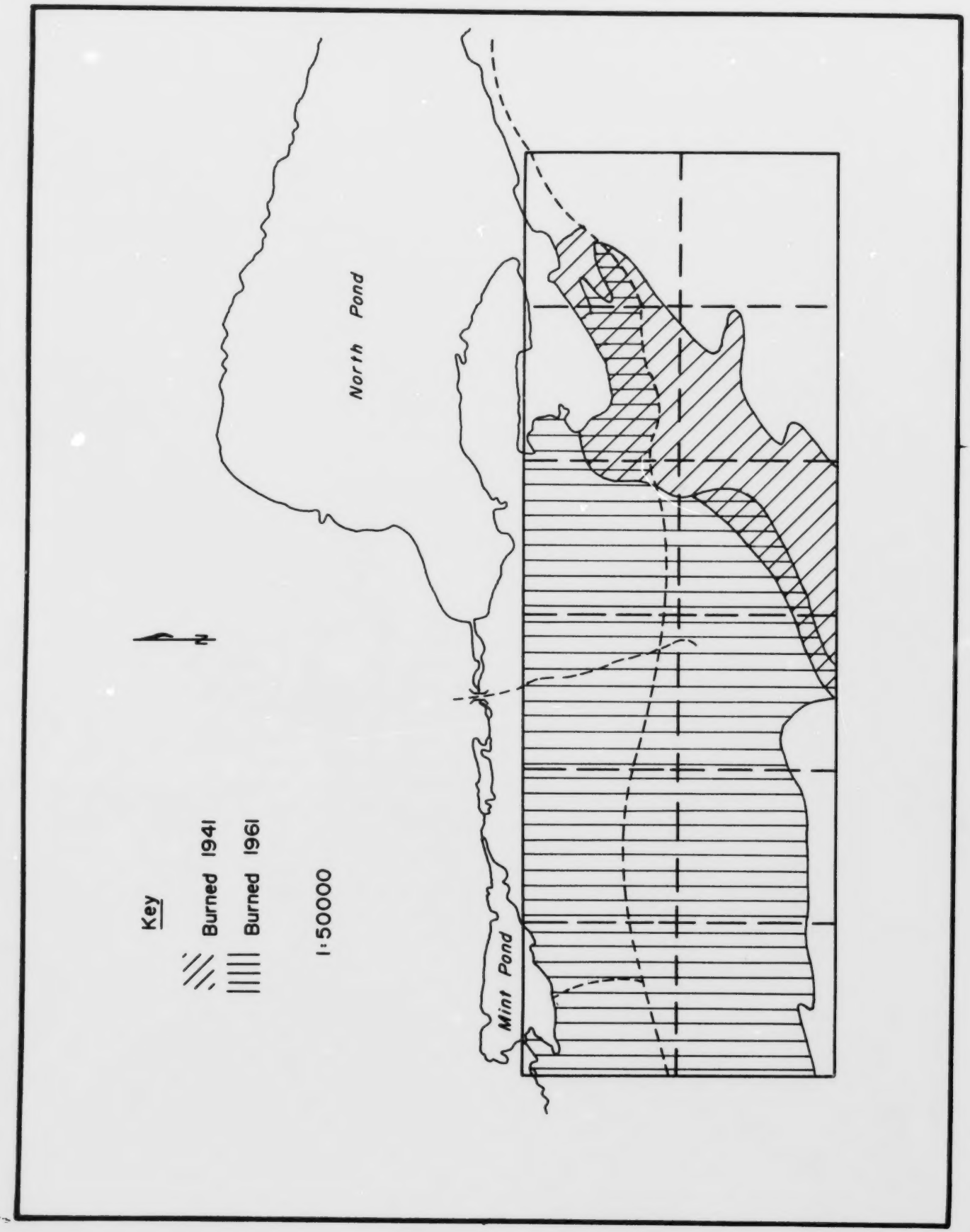


Figure 2.

North Pond Forest Experimental Area — Showing Forest Fire Coverage.

The 1964-65 regeneration survey provided considerable information about the regeneration status and ecological conditions of the burned area. This survey employed plots of five contiguous milacre quadrats spaced four chains (80 m) apart along survey lines. These lines were originally intended to be run four chains (80 m) apart but only a small proportion of the area was surveyed at this intensity. The remainder was surveyed with lines spaced alternately eight and twelve chains (160 and 240 m) apart. Site conditions and vegetation were examined as well as softwood and hardwood reproduction.

Overall, 40 percent of the 6,305 milacre quadrats surveyed were stocked to black spruce, the commonest softwood species. A plot containing at least three quadrats stocked out of five was considered to be 'satisfactorily stocked'. On this basis, 38.5 percent of the surveyed area was satisfactorily stocked to black spruce. The stocked area was found largely to the north of the main east-west road through the experimental area. At the west end and south of the road there was very little satisfactory stocking. In the eastern part of the area, best stocking was found on the higher, drier ground away from the valley bottoms. Throughout the area the regeneration pattern was somewhat irregular, with well-stocked patches occurring within understocked areas and vice versa.

Mean black spruce seedling density was 4 200 stems/ha. Hardwood densities were much greater - 5 400 stems/ha white birch and 6 900 stems/ha trembling aspen. These hardwoods were dominant throughout most of the 1961 fire area, but were much less common on the poorer site conditions of the 1941 burn. At the time of the survey, hardwood competition was considered to be an important future problem which would require serious investigation.

Though balsam fir was a major component in the stands which were present before cutting and fire, balsam fir regeneration was very scarce after the 1961 fire. Average density was only 250 stems/ha. Because of its seed production characteristics balsam fir does not normally regenerate after fire and reproduction present on the ground is usually destroyed by fire.

Black spruce seedlings were found most commonly in a Dicranum or Polytrichum moss seedbed on organic layers 1.0-1.25 cm deep and associated with herbs such as Epilobium angustifolium, Rubus idaeus, Cornus canadensis and Clintonia borealis. Other localized seedbeds which proved favourable for black spruce were rotting wood, Sphagnum moss, feather mosses and lichen. Charred humus was unfavourable.

Site Types

On the basis of the ecological data collected in the 1964-65 regeneration survey, a number of site types were recognized (Figure 3). These represent various combinations of soil texture, soil moisture, ground vegetation, regeneration species and density, and former stand type. Since the location of much of the experimental work is largely related to site type, it will be useful to describe the characteristics of these types and give some indication of how they have changed since then.

1. Non-regenerating rich lower slopes. These sites originally supported a high proportion of balsam fir. After cutting and the 1961 fire, only scattered dead white birch remained standing. Soils are stony and somewhat moist. Black spruce regeneration is inadequate but reproduction of birch and aspen is abundant in some places. Elsewhere in 1964-65, the ground vegetation was dominated by pin cherry (Prunus pensylvanica L.f.) which has since largely died out. There is now a complete carpet of Polytrichum or Dicranum moss. Regeneration growth on this site is excellent and a number of plantations and seeding studies were established on it. It occurs at the west end of the area, south of the main road.

2. Very stony non-regenerating rich lower slopes. This is quite similar to the previous site type, and like it, originally supported balsam fir. The soil is extremely stony with 80 percent surface cover of stones and rocks when surveyed. Between the rocks are pockets of mucky soil. Birch and aspen reproduction predominates. Sedges, fireweed and raspberry were the most common ground vegetation species. The pioneering fireweed and raspberry no longer occur, but sedges and grasses are still common. Reforestation of this type is difficult and no plantations were established on it. The type occurs on the slopes north of the main road at the west end.

3. Regenerating lower slopes. Original stands on these sites were probably mixed spruce and fir. Individual stems and clumps of small scrubby cone-bearing dead spruce remained after the fire. The soil is stony with a humus layer 2 to 3 cm deep. Black spruce regeneration is adequate with relatively few hardwoods. In 1964-65, ground vegetation consisted of pioneer species such as fireweed and raspberry over a Dicranum or Polytrichum moss carpet. The pioneer species have been replaced by other low herbs which offer little competition to the spruce. Few plantations were established on this type which occurs throughout the western half of the area north of the main road.

4. Twice-burned rich lower slopes. Prior to 1941, stands on this type probably contained much black spruce. Spruce regeneration was present before the 1961 fire. As a result of the two fires, the humus layer in 1964-65 was very thin or non-existent. The soil is stony and

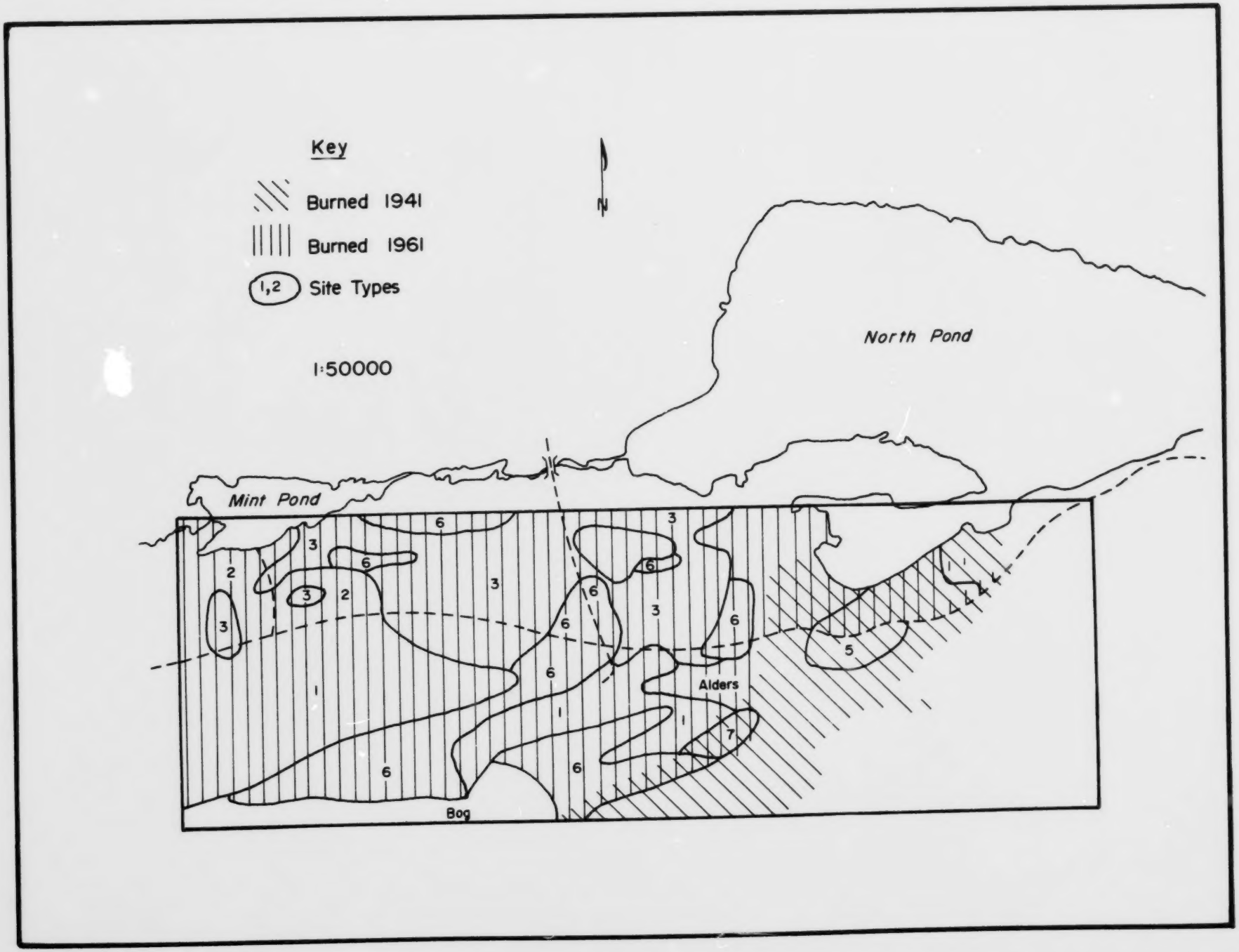


Figure 3: North Pond Forest Experimental Area — Site Types.

relatively dry. Ground vegetation was sparse, with Dicranum and Polytrichum moss and fireweed just beginning to invade three years after the fire. There is now some black spruce regeneration. Alders have become dominant over much of this type, growing and spreading rapidly. Where not subject to alder competition, black spruce growth is good. This type occurs between the main road and the south shore of North Pond and several studies have been established on it.

5. Non-regenerating 1941-burned flat. This is a largely barren area with a dry to moist sandy soil. Humus depth varies from 2 cm on dry knolls to 30-60 cm of peat on the moist flatter areas. The vegetation is dominated by ericaceous dwarf-shrubs over a lichen carpet. The only trees consist of scattered slow-growing black spruce or larch. This type occurs south of the main road in the central depression. It presents opportunities for mechanical site preparation which has been tried, but is quite nutrient-poor and unfavourable for reforestation.

6. Nutrient-poor upper slopes. These sites originally supported slow-growing dense black spruce stands on upper slopes or ridge-tops. The soil is fairly well-drained and relatively infertile with a humus layer 8-15 cm deep. Ericaceous dwarf-shrubs dominate the ground vegetation with well-developed Kalmia mounds. Since 1964-65, a lichen carpet has gradually developed. Where the spruce stands were not cut before the 1961 fire, spruce regeneration is adequate; elsewhere it is lacking. Hardwood reproduction is uncommon. Growth of black spruce since the fire has been slow on this nutrient-poor site. This type occurs in the western half of the area, on the upper gentle slopes and ridges south of the road and on flatter areas north of the road. It has not been much used for trials.

7. Nutrient-poor twice-burned upper slopes. Original stands probably contained fir and spruce. The soil is a well-drained to somewhat moist sandy loam with a humus layer about 5 cm deep. Ericaceous dwarf-shrubs dominate the ground vegetation but Kalmia mounds are absent. Bracken fern was a frequent component of the vegetation in 1964-65 but is less frequent now. Alders are becoming increasingly dominant. Black spruce regeneration is generally inadequate and hardwoods are uncommon. This type, which occurs south of the central depression, offered good opportunities for scarification trials in the early years after the 1961 fire, and is favourable for reforestation.

Several other site types were recognized, but they are either of limited extent, or unsuitable for reforestation activities. Examples of these are the Sphagnum bog on the south boundary of the area, and the alder swamps found particularly in the central depression.

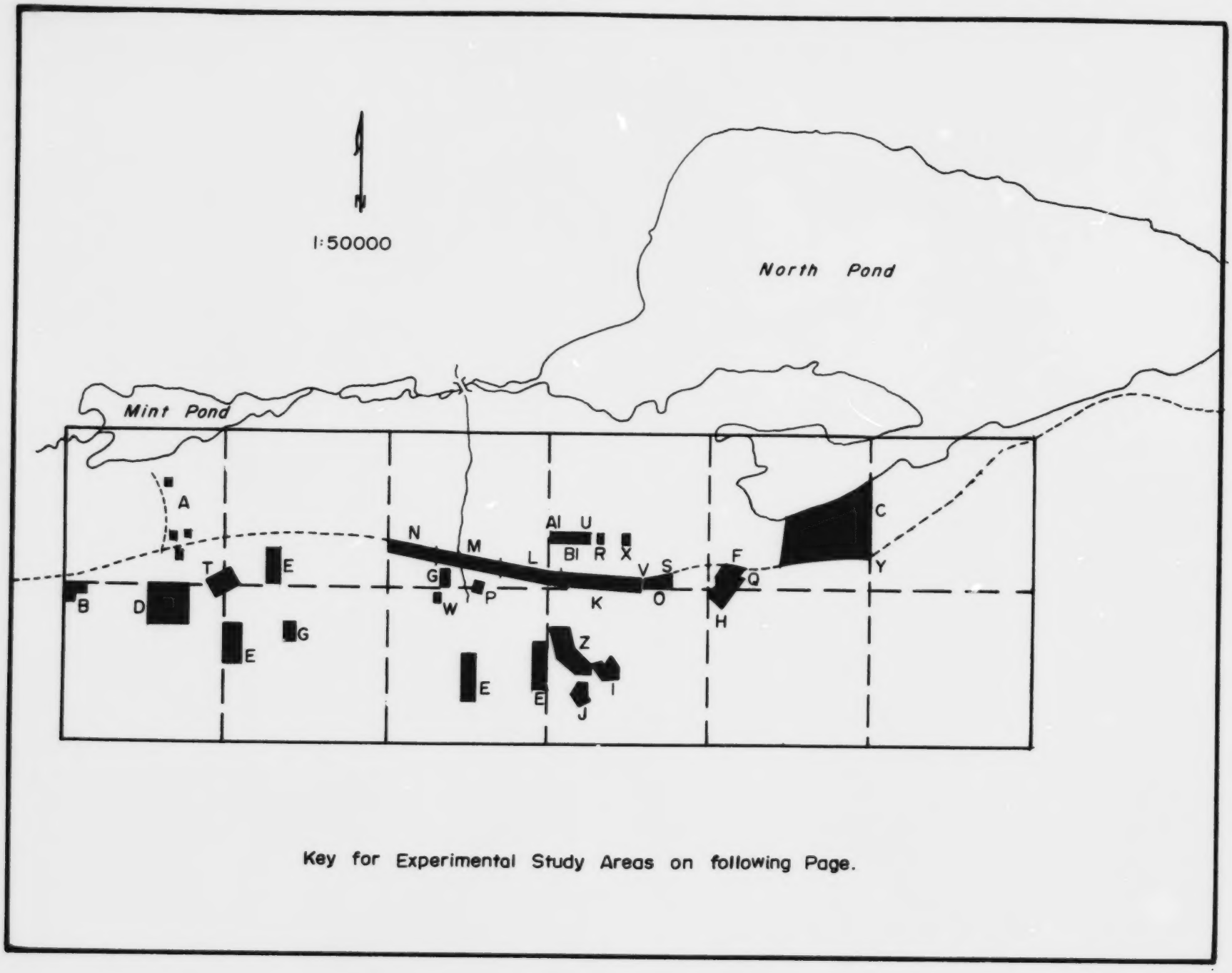
Scope of Experimental Work and Demonstrations

The first experiment established on the experimental area after the 1961 fire was a direct seeding trial with Sitka spruce (Picea sitchensis (Bong.) Carr.) which was started in 1962. Between then and 1969, a total of 29 different experiments and demonstrations were established. Another trial was started in 1975 which was concerned with stand tending rather than stand establishment, and such 'second generation' trials may continue to be established. Figure 4 (and its accompanying key) shows the locations of the trials in relation to each other.

All the established trials are described in the following pages in a uniform format. Objectives, site, design and history of the study are stated briefly, and reports and publications are listed. Location of the study is shown on a map of the experimental area, and a more detailed plan of the study itself is provided. Results of remeasurements are summarized briefly, and an 'assessment of results' discusses conclusions and their possible significance.

The trials are grouped into four main subject areas: direct seeding, planting, tree improvement, and stand tending. There is, however, some overlap among these groups. Table 1 provides basic information on the four groups of trials.

Included within the direct seeding and planting trials are series of studies, identified by numbers 66- or 67-, which were established as demonstrations of reforestation techniques and species rather than more formal scientific experiments. The present document contains the first published information on the survival and growth of these demonstrations.



Key for Experimental Study Areas on following Page.

Figure 4 North Pond Forest Experimental Area — Location of all Studies.

Key to Figure 4

A	NF-70
B	NF-78
C	NF-84
D	NF-85
E	NF-98
F	6-S-66
G	1-S-67
H	66-11
I	66-12
J	66-13
K	67-28
L	67-29
M	67-30
N	67-31
O	NF-79
P	3-S-66
Q	5-S-66
R	2-S-68
S	67-27
T	NF-76
U	NF-81
V	NF-88
W	4-S-66
X	13-S-67
Y	Alder Control Study
Z	Spacing Trial in Immature Black Spruce
A1	Demonstration Seed Production Areas
B1	Topping Study on Black Spruce

Table 1. Trials and demonstrations at North Pond Experimental Area.

Study No.	Title	Date established	Map page
A. Direct Seeding			
NF-70	Sitka spruce broadcast seeding	1962-4	23
NF-78	Black spruce seedspotting	1964-6	29
NF-84	Aerial seeding	1965	35
NF-85	Broadcast seeding black spruce	1963	41
NF-98	Black spruce broadcast seeding on Rome discer scarification	1964	47
6-S-66	Black spruce seedspotting on SFI scarification	1966-7	53
1-S-67	Comparison of seeding methods on SFI scarification	1967-8	59
66-11	Spruce and pine broadcast seeding on SFI-scarified barren	1966-9	65
66-12	Black spruce broadcast seeding on SFI scarification	1966	71
66-13	Black spruce broadcast seeding on SFI scarification	1966	77
67-28	Anchor chain scarification and seeding or planting	1967	84
67-29	SFI scarification and seeding or planting	1967	91
67-30	Anchor chain scarification and seeding	1967	97
67-31	Scarification and seeding or planting	1967	103
B. Planting			
NF-79	Sitka spruce bullet planting	1964-5	109
3-S-66	Ontario tubeling planting	1966	115
5-S-66	Black spruce planting on SFI scarification	1966-7	121
2-S-68	Sitka spruce comparison of planting stock	1968	127
67-27	Scots pine planting on SFI scarification	1967	131
67-28	Anchor chain scarification and seeding or planting	1967	82
67-29	SFI scarification and seeding or planting	1967	90
67-31	Scarification and seeding or planting	1967	101

... Cont'd.

Table 1 (Concl'd.)

Study No.	Title	Date established	Map page
C. Tree Improvement			
NF-76	White spruce provenance trial	1963	139
NF-81	Arboretum	1964-73	146
NF-88	Red spruce provenance trial	1964	152
4-S-66	Plantation trial of Pinus spp.	1966	159
13-S-67	Sitka spruce provenance trial	1969	165
	Demonstration seed production areas	1977	171
	Topping study on black spruce	1978	177
D. Stand Tending			
	Alder control study	1975	183
	Spacing trial in immature black spruce	1981	189

Annotated Bibliography

The following reports and publications refer in whole or in part to North Pond in a general sense or with reference to aspects of the research carried on there which are not covered in the descriptions of individual studies.

Chaffey, V. 1970. North Pond Experimental Area. Summary of experiments and supporting work 1969. Can. Dep. Fish. & Forest., Can. Forest. Serv., Internal Report N-30, 17 p.

Brief description of all studies active in 1969 and fieldwork carried on that year.

Dickson, W.A. 1952. Progress Report. Regeneration of burned-over areas. Project NF-7. Can. Dep. Res. & Dev., Forest. Br., St. John's, Nfld. 56 p. +.

Describes results of regeneration surveys carried out in 1951 on the area burned in 1941 (as well as on several other recently burned areas).

Dickson, W.A. and D.E. Nickerson. 1958. Factors affecting natural regeneration on cut-over and burned-over lands, Newfoundland. Can. Dep. N. Aff. & Nat. Res., Forest. Br., Forest Res. Div., Report S & M 58-3. 16 p.

Further analysis of 1951 regeneration surveys.

Evans, C.H. and E.C. Salter. 1969. Record of silvicultural trials and demonstrations. Can. Dep. Fish. & Forest., Forest. Br., Internal Report N-11, 204 p.

Basic information on establishment of scarification, seeding and planting demonstrations at North Pond (66-11, 12, 13; 67-27, 28, 29, 30, 31) and other parts of Newfoundland.

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Hall, J. Peter. 1982. Trials of exotic species and genetic improvement of larch in Newfoundland. In Proceedings of the eighteenth meeting of the Canadian Tree Improvement Association. Part 1, Env. Can., Can. Forest. Ser., Ottawa. pp. 216-220.

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Basic data on areas surveyed in 1970, including 24 regeneration survey 'units' in the North Pond area.

Newfoundland Forest Protection Association. 1961. Newfoundland For. Protection Assoc. Annual Report. St. John's, Nfld.

Page, G. and A.J. Robinson. 1969. The development of young stands of native spruce and fir in Newfoundland. Can. Dep. Fish & Forest., Can. Forest. Serv., Information Report N-X-33. 31 p.

Analysis of growth and development information from a number of earlier studies of natural and artificial regeneration, including NF-84 and NF-98 at North Pond.

Richardson, J. 1965. Progress report. Phenological observations at North Pond Experimental Area. Project NF-77. Can. Dep. Forest., Forest Res. Br., Mimeo. 65-N-3. 15 p.

Observations made on a small number of mature and immature stems of common tree species in 1964.

Richardson, J. 1965a. File report. North Pond meteorological station report, 1964. Project NF-80. Can. Dep. Forest., Nfld. Region, Mimeo, 65-N-6. 27 p.

Data collected at weather station at North Pond, May-November 1964.

Richardson, J. 1965b. North Pond meteorological station report 1965. Can. Dep. Forest., Nfld. Region, St. John's, Nfld. Unpubl. report. 28 p.

Data collected at weather station at North Pond, May-November 1965.

Richardson, J. 1967. North Pond. A burned-land reforestation research area in Newfoundland. Sylva 48:6-9.

General description of rationale for North Pond and studies underway in mid-1960's, prepared for annual journal of Edinburgh University Forestry Society.

Richardson, J. 1967a. Summary of experiments and studies being carried out at North Pond Forest Experimental area. Can. Dep. Forest. & Rur. Dev., Forest. Br., Information Report N-X-5. 28 p.

Brief description of all studies active in 1966 and fieldwork carried on that year.

Richardson, J. 1969. A study of germination and first-year development and survival of black spruce. MScF thesis, Univ. New Brunswick, Fredericton, N.B. 124 p.

Reviews literature on direct seeding and describes study carried on at North Pond involving following development and fate of individual seeds sown on prepared spots.

Richardson, J. and J. Peter Hall. 1973. Natural regeneration after disturbance in the forests of central Newfoundland. Environ. Can., Can. Forest Serv., Information Report N-X-86. 63 p.

Complete analysis of regeneration survey data collected in 1970, including information from North Pond and area.

Richardson, J. and D.E. Nickerson. 1966. Status of work as at May 1, 1966. North Pond Forest Experimental Area. Can. Dep. Forest., Nfld. Region, St. John's, Nfld., Unpubl. report. 13 p.

Brief description of all studies active in 1966 and fieldwork carried out in 1965 and/or proposed for 1966.

Robertson, A.W. 1970. Seed and planting stock supply service. 1970-71 work program. Can. Dep. Fish. & Forest., Can. Forest. Serv., Forest Res. Lab., St. John's, Nfld. File Report. 20 p.

Includes description of work proposed for North Pond nursery - mainly removal of stock.

Robertson, A.W. 1971. Regional seed and planting stock supply service. Annual report for the fiscal year 1970-71. Can. Dep. Fish. & Forest., Can. Forest. Serv., Forest Res. Lab., St. John's, Nfld., File Report. 38 p.

Includes inventory of stock in North Pond nursery in fall 1970.

Robertson, A.W. and V. Chaffey. 1970. Inventory and movements of stock at Pasadena and North Pond Forest Research nurseries - 1969. Can. Dep. Fish. & Forest., Can. Forest. Serv., Forest Res. Lab., St.John's, Nfld., File Report. 20 p.

Inventory of stock in North Pond nursery in fall 1969.

Robinson, A.J. 1971. A comparison of seven regeneration sampling methods. Can. Dep. Fish. & Forest., Can. Forest. Serv., Forest Res. Lab., St. John's, Nfld. File Report. Project N055. 20 p.

Report of a study carried out at North Pond.

Salter, E.C. and C.H. Evans. 1976. Record of silvicultural trials and demonstrations - Volume 2. Environ. Can., Can. Forest. Serv., Information Report N-X-137. 113 p.

Updates Evans and Salter (1969). Only North Pond demonstration included is 66-11.

Singh, P. and J. Richardson. 1973. Armillaria root rot in seeded and planted areas in Newfoundland. Forest. Chron. 49(4):180-2.

Most direct seeding studies and some plantations at North Pond were included in survey reported here.

Wilton, W.C. 1962. Selection of a forest experimental area. Project NF-71. Can. Dep. Forest., Forest Res. Br., St. John's, Nfld. File Report.

Outlines criteria used in selection of North Pond Experimental Area.

Wilton, W.C. 1964. General research plan. North Pond Experimental Area. Project NF-71. Can. Dep. Forest., Forest Res. Br., Mimeo 64-N-1. 11 p.

Outlines in general terms scope of research to be undertaken at North Pond, and also supporting work.

Wilton, W.C. and C.H. Evans. 1974. Newfoundland forest fire history 1619-1960. Environ. Can., Can. Forest. Serv., Information Report N-X-116. 114 p.

Refers briefly to several fires in North Pond area, most recently the 1941 fire.

Wilton, W.C. and E.C. Salter. 1969. Scarification trials in Newfoundland. Can. Dep. Fish. & Forest., Forest. Br., Information Report N-X-32. 14 p.

Earliest trials of SFI scarifier in Newfoundland were conducted at North Pond.

THE STUDIES

A. DIRECT SEEDING

NF-70 - SITKA SPRUCE BROADCAST SEEDING

A small-scale experiment on four slightly different site conditions, designed to determine if Sitka spruce can be established successfully in Newfoundland by direct seeding without site preparation, and if so, the optimum broadcast seeding rate.

Site. There are four sites, labelled A, B, C, D on maps. All fall within Site Type 1 (p. 8).

A - fresh to moist upper slope; thin organic layer, moss carpet with some Kalmia; pin cherry and aspen saplings.

B - moist mid-slope; thin organic layer; moss carpet with herbs and Kalmia; aspen and pin cherry saplings.

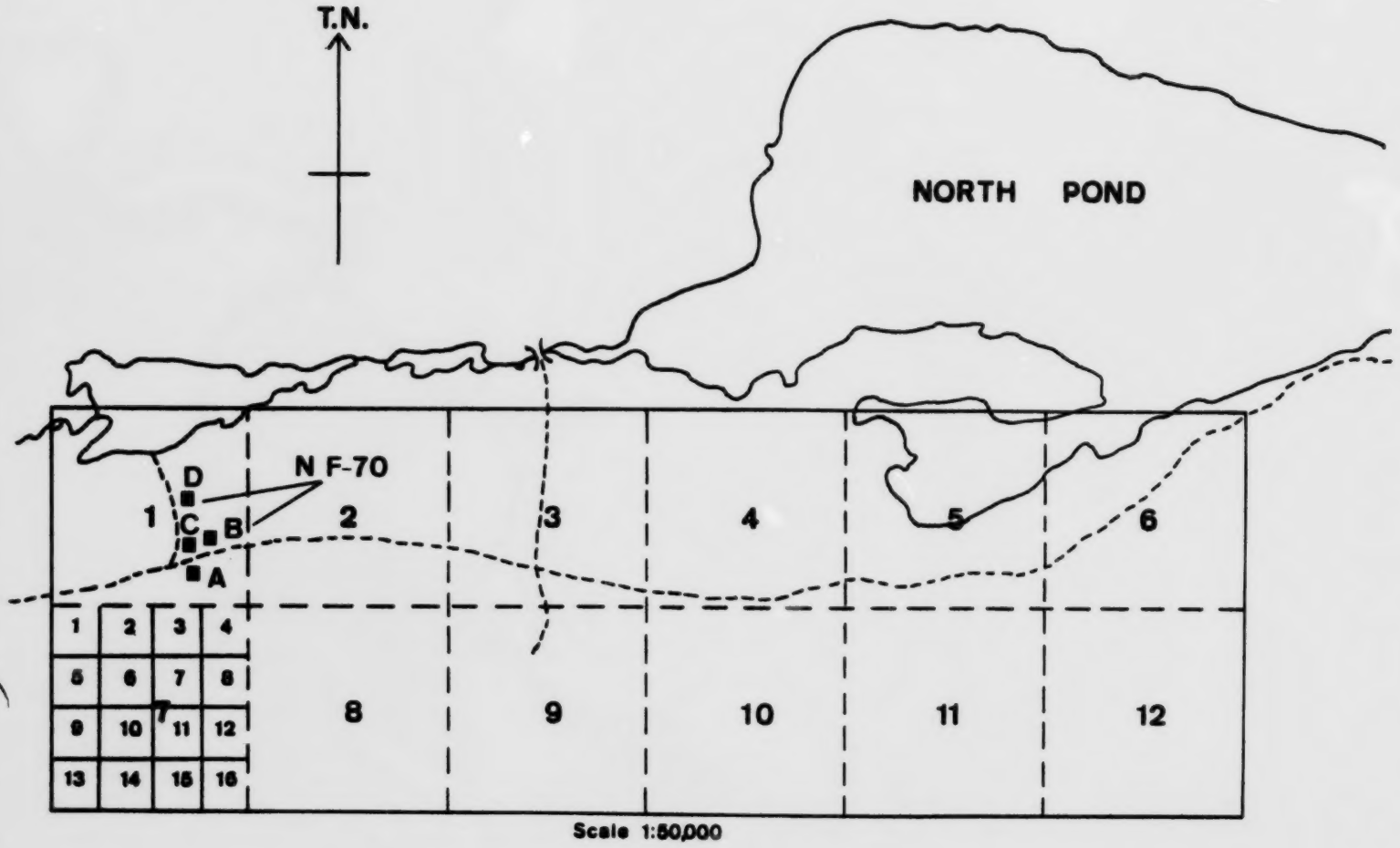
C - fresh to moist mid-slope; thin organic layer; moss carpet with herbs; vigorous aspen and pin cherry saplings.

D - fresh rocky ridge; very thin organic layer; moss carpet with Kalmia; aspen and birch seedlings.

All sites originally supported balsam fir-black spruce-white birch stands which were cutover for pulpwood in 1959 and burned by wildfire in 1961.

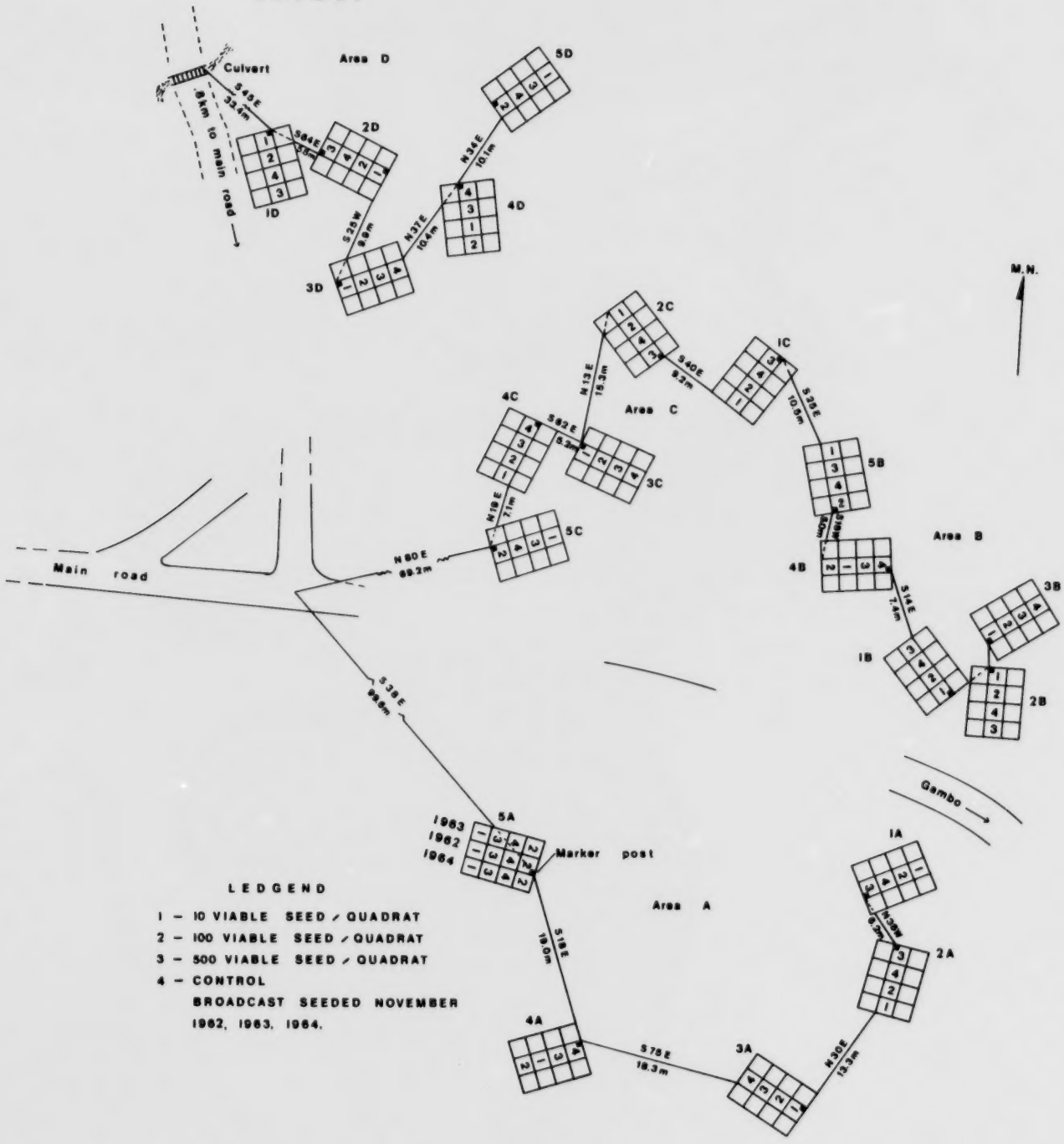
Design. Randomized block with factorial arrangement of treatments.
Five replicates on each of four sites.
Four broadcast seeding intensities (0, 10, 100, 500 viable seed per milacre quadrat (4 m^2)).
Three years of seeding (1962, 1963, 1964).
Twenty blocks, each 48 m^2 - total area 0.09 ha.
Seeding by hand using Sitka spruce seed of Terrace, B.C. origin.

History. Established November 1962-64.
Complete remeasurement June 1970.
Remeasured again September 1978.
Cleaned summer 1980.



NF-70 SITKA SPRUCE BROADCAST SEEDING LAYOUT

NF-70 SITKA SPRUCE BROADCAST SEEDING LAYOUT



LEDGEND

1 – 10 VIABLE SEED / QUADRAT
2 – 100 VIABLE SEED / QUADRAT
3 – 500 VIABLE SEED / QUADRAT
4 – CONTROL

BROADCAST SEEDED NOVEMBER 1962, 1963, 1964.

NF-70 SITKA SPRUCE BROADCAST SEEDING

Sitka spruce seedlings between roots of burned stumps; 1970.

Tallest Sitka spruce in study, Area C, March 1979.

Results:

Sitka spruce stocking and seedling density:

Sowing density (viable seed/ quadrat)	Sown 1962				Sown 1963				Sown 1964				Average			
	Percent stocking		Seedlings/ quadrat		Percent stocking		Seedlings/ quadrat		Percent stocking		Seedlings/ quadrat		Percent stocking		Seedlings/ quadrat	
	1970	1978	1970	1978	1970	1978	1970	1978	1970	1978	1970	1978	1970	1978	1970	1978
0	10	5	0.2	0	5	0	0	0	5	5	0	0	7	3	0.1	0
10	50	40	0.6	0.4	45	60	0.6	0.9	20	15	0.3	0.2	38	38	0.5	0.5
100	90	90	7.8	5.0	80	80	5.9	4.8	65	73	2.0	1.6	78	81	5.2	3.8
500	100	100	26.0	15.8	100	100	23.7	15.4	95	90	7.8	7.1	98	97	19.2	12.0
Average	62	59	8.6	5.3	58	60	7.6	5.3	42	41	2.5	2.2	55	53	6.2	4.3

Sitka spruce growth:

Sowing year	Tallest Seedling Per Quadrat		
	Average height (m)		Average leader (m)
	1970	1978	1978
1962	0.41	1.50	0.18
1963	0.24	1.08	0.14
1964	0.16	0.88	0.13
Average	0.28	1.18	0.15

Sitka spruce performance by site:

Site	Percent stocking		Seedlings/quad.		Tallest Seedling/Quadrat		
					Avg. Height (m)		Avg. leader (m)
	1970	1978	1970	1978	1970	1978	1978
A	54	52	4.8	3.2	0.33	1.04	0.12
B	59	52	6.8	3.9	0.29	1.23	0.15
C	50	48	4.4	3.3	0.33	1.72	0.26
D	62	62	9.2	6.7	0.18	0.83	0.11

NF-70 SITKA SPRUCE BROADCAST SEEDING

Assessment of Results

Sitka spruce can be broadcast seeded successfully on these sites.

Best stocking and seedling density came from the highest sowing density (500 viable seed/quadrat - 1 236 000/ha). Optimum falls between 10 and 100 viable seed/quadrat (25 000 - 247 000/ha). Seedlings on unseeded quadrats probably originated from seeds blown or washed from adjacent seeded quadrats.

Sowings in 1964 resulted in lower stocking and seedling density, perhaps due to droughty conditions during 1965 growing season (precipitation 30 percent below normal).

Best stocking and seedling density occurred on Site D where the organic soil covering was minimal, but best seedling growth occurred on Site C where soil conditions are moister and natural vegetation indicates relatively nutrient-rich conditions.

Data from 1978 confirmed 1970 results and showed that growth rates have increased.

Reports and Publications

Howard, E.W. 1964. Determination of quantity of Sitka spruce seed required per unit area for broadcast seeding of recently burned land. Can. Dep. For., For. Res. Br., Mimeo. 64-N-3. 7 p.

Richardson, J. 1972. Broadcast seeding Sitka spruce on a burned cutover. Environ. Can., Forest. Serv., Information Report N-X-72. 16 p.

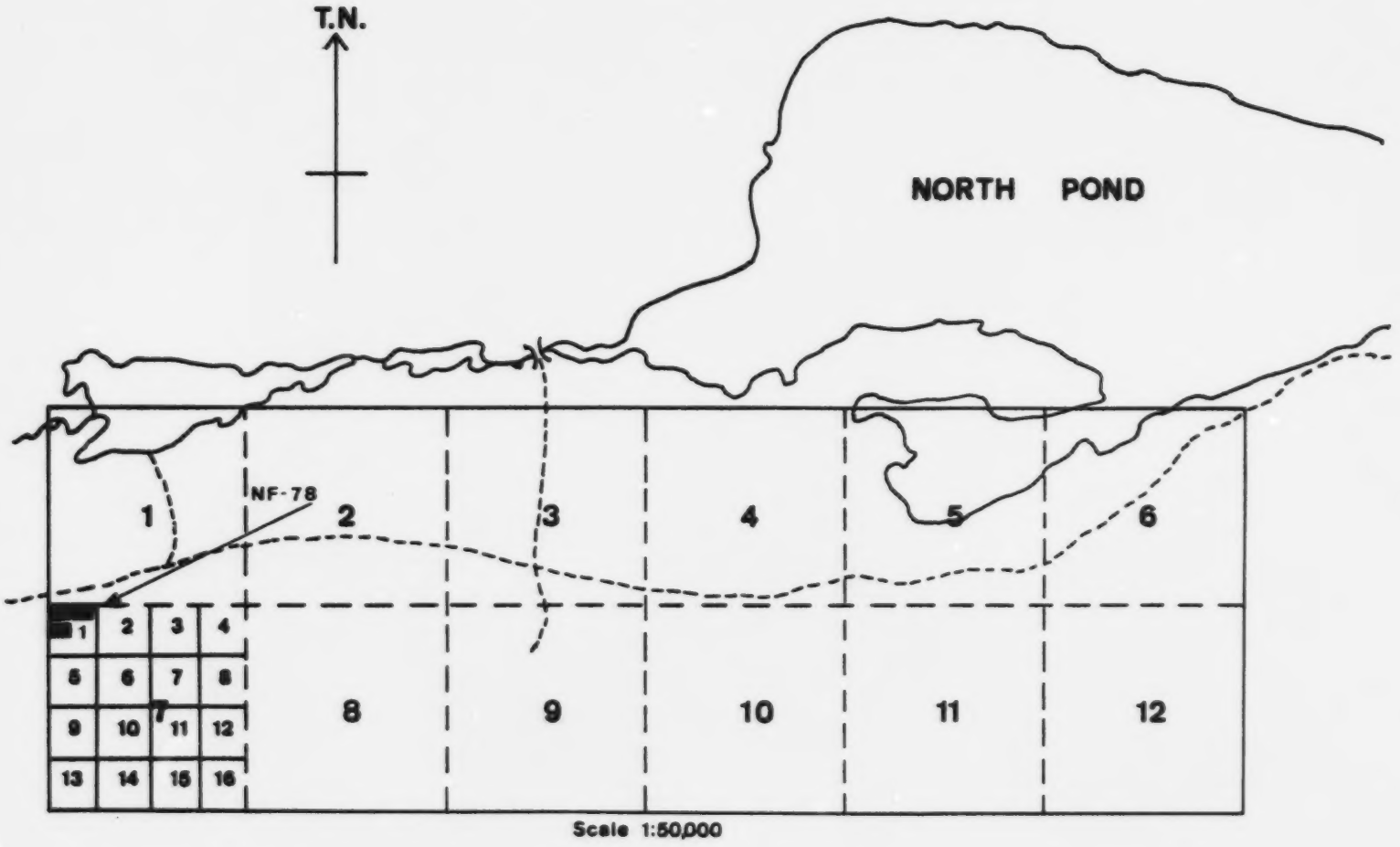
NF-78 - BLACK SPRUCE SEEDSPOTTING

A medium-scale experiment designed to compare a series of seeding dates throughout the growing season from June to October, using seedspotting without site preparation.

Site. Original balsam fir-black spruce-white birch stand cut for pulpwood 1957-58 prior to wildfire in 1961. Gentle undulating north slope with dry to wet soil conditions but chiefly fresh to moist. Organic layer is thin on drier sites where moss carpet is chief vegetation. Alder thickets occupy wet sites. At the time of seeding, pin cherry, raspberry and fireweed dominated fresh sites. Subsequently, white birch, sedges and grass became established on moist to wet sites, aspen on dry to fresh sites. (Site Type 1 and 2, p. 8)

Design. Randomized block with factorial arrangement of treatments.
Three replications with varying site conditions.
Ten seeding dates at two-week intervals from early June to early October.
Three years of seeding (1964, 1965, 1966).
Each treatment combination represented by two rows of approximately 50 seedspots at 2 m intervals in each block.
About 10 black spruce seed (central Newfoundland origin) sown by hand on spot scuffed by foot for each seedspot.
Each block 1 ha in area - total area 3 ha.

History. Established 1964-66.
Complete remeasurement late summer 1969.
Partial remeasurement June 1979. Only one seeding date (the best in 1969) examined in each block and one row of seedspots for each seeding year (i.e. 5 percent of experiment).
Block 1 cleaned summer 1980.
Blocks 1 and 2 cleaned and seedspots in Block 1 thinned, summer 1983.



Scale 1:50,000

NF-78 BLACK SPRUCE SEEDSPOTTING LOCATION

NF-78 BLACK SPRUCE SEEDSPOTTING LAYOUT

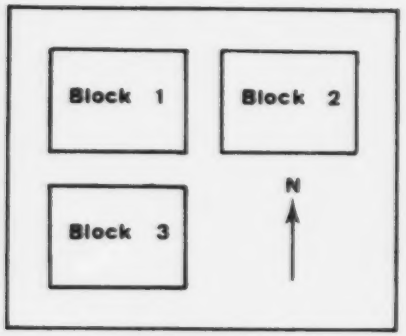
LEGEND

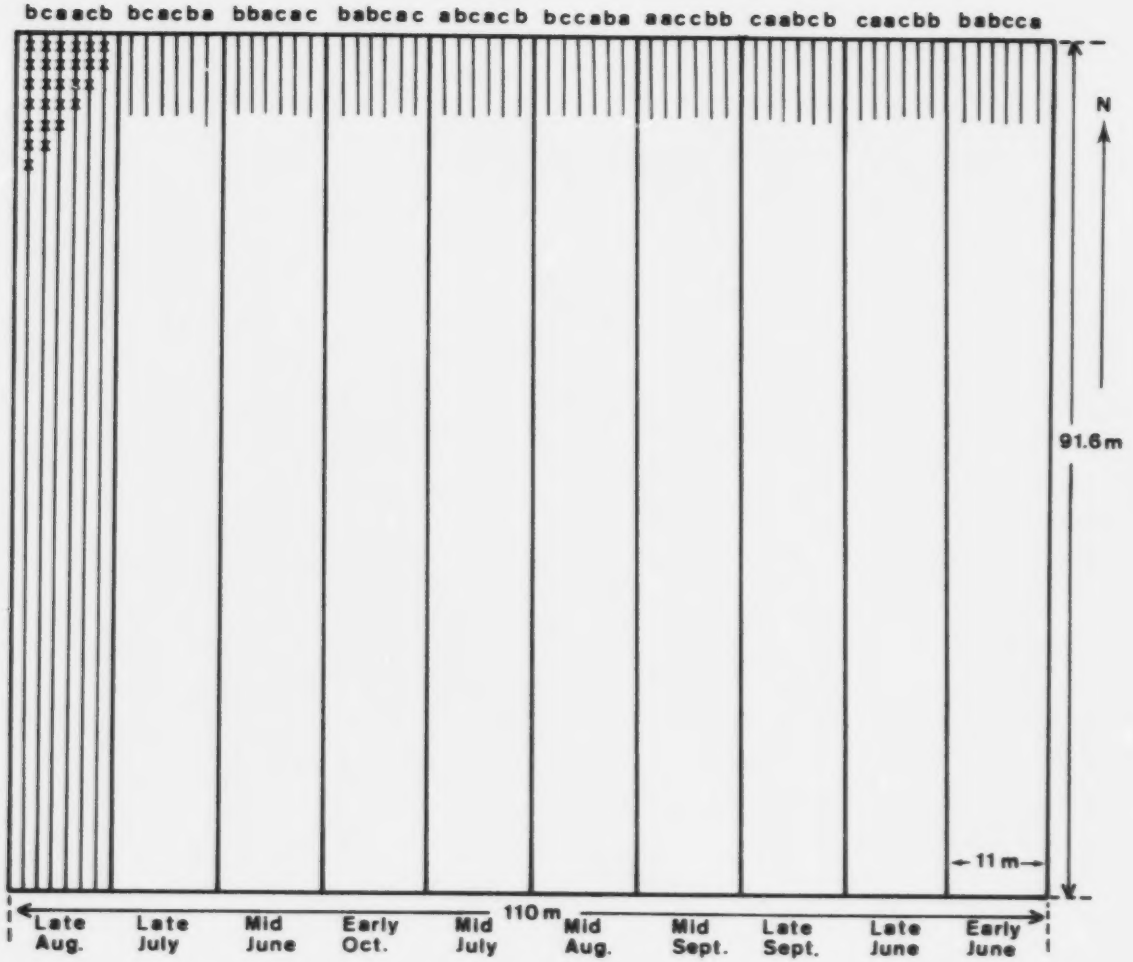
Lines and seedspots are speced 2m apart.

Treatments are randomised similarly in each block.

a - 1964
b - 1965 — Seeding year
c - 1966
x - Seedspot

Scale 1:720





NF-78 - BLACK SPRUCE SEEDSPOTTING

Black spruce seedspot sown in 1966, photo September 1969.

Black spruce seedspots (several seedlings in each) sown in 1964, photo June 1973.

NF-78 - BLACK SPRUCE SEEDSPOTTING

Results*

Black spruce seedspot stocking (percent) by year and sowing date:

	Date											
Year	Early June	Mid-June	Late June	Mid-July 1969	Mid-July 1979	Late July	Mid-Aug.	Late Aug.	Mid-Sept	Late Sept	Early Oct.	All dates
1964	25	34	33	48	55	46	28	46	40	46	53	40
1965	39	33	33	34	61	19	28	27	20	29	30	29
1966	29	28	30	34	59	20	12	11	17	9	10	20
All years	31	32	32	39	45	28	23	28	26	28	31	30

Average number of black spruce seedlings per stocked spot:

	Date											
Year	Early June	Mid-June	Late June	Mid-July 1969	Mid-July 1979	Late July	Mid-Aug.	Late Aug.	Mid-Sept	Late Sept	Early Oct.	All dates
1964	3.1	3.0	3.9	5.2	5.4	6.0	4.2	4.0	3.3	3.8	5.5	4.3
1965	6.4	4.5	3.6	4.9	3.9	4.3	3.5	4.0	2.4	5.1	4.6	4.5
1966	4.4	3.0	3.8	5.8	4.6	2.8	2.0	1.4	2.6	2.1	2.5	3.6
All years	4.9	3.5	3.8	5.3	4.7	4.9	3.5	3.7	2.9	4.1	4.9	4.2

Average height of tallest seedling per stocked seedspot (cm):

	Date											
Year	Early June	Mid-June	Late June	Mid-July 1969	Mid-July 1979	Late July	Mid-Aug.	Late Aug.	Mid-Sept	Late Sept	Early Oct.	All dates
1964	38	33	41	31	133	25	29	27	27	31	29	30
1965	25	24	25	22	105	17	22	19	18	19	16	23
1966	18	14	14	12	124	10	10	9	8	11	13	13
All years	25	25	26	23	122	23	23	22	20	24	23	23

*All data are from 1969 remeasurement except where noted otherwise.

NF-78 - BLACK SPRUCE SEEDSPOTTING

Assessment of Results

Seedspotting of black spruce was only moderately successful at best.

No sowing date between early June and mid-October proved distinctly superior, but seeding before mid-July was generally better than seeding later. Percent stocking declined throughout the three-year establishment period, perhaps due to weather conditions which were more unfavourable in the later years.

Most seedspots had a dense clump of seedlings which will require thinning for optimum growth.

Better height growth in seedspots sown in first half of growing season than in second half.

Fresh sites with very shallow organic layer and moss carpet had the best seedspot stocking.

Reports and Publications

Wilton, W.C. 1965. Black spruce seedspotting. Project NF-78. Can. Dep. Forest., Forest Res. Br., St. John's, Nfld., File Report.

Richardson, J. 1972. Seedspotting black spruce throughout the growing season. Environ. Can., Forest. Serv., Information Report N-X-69. 16 p.

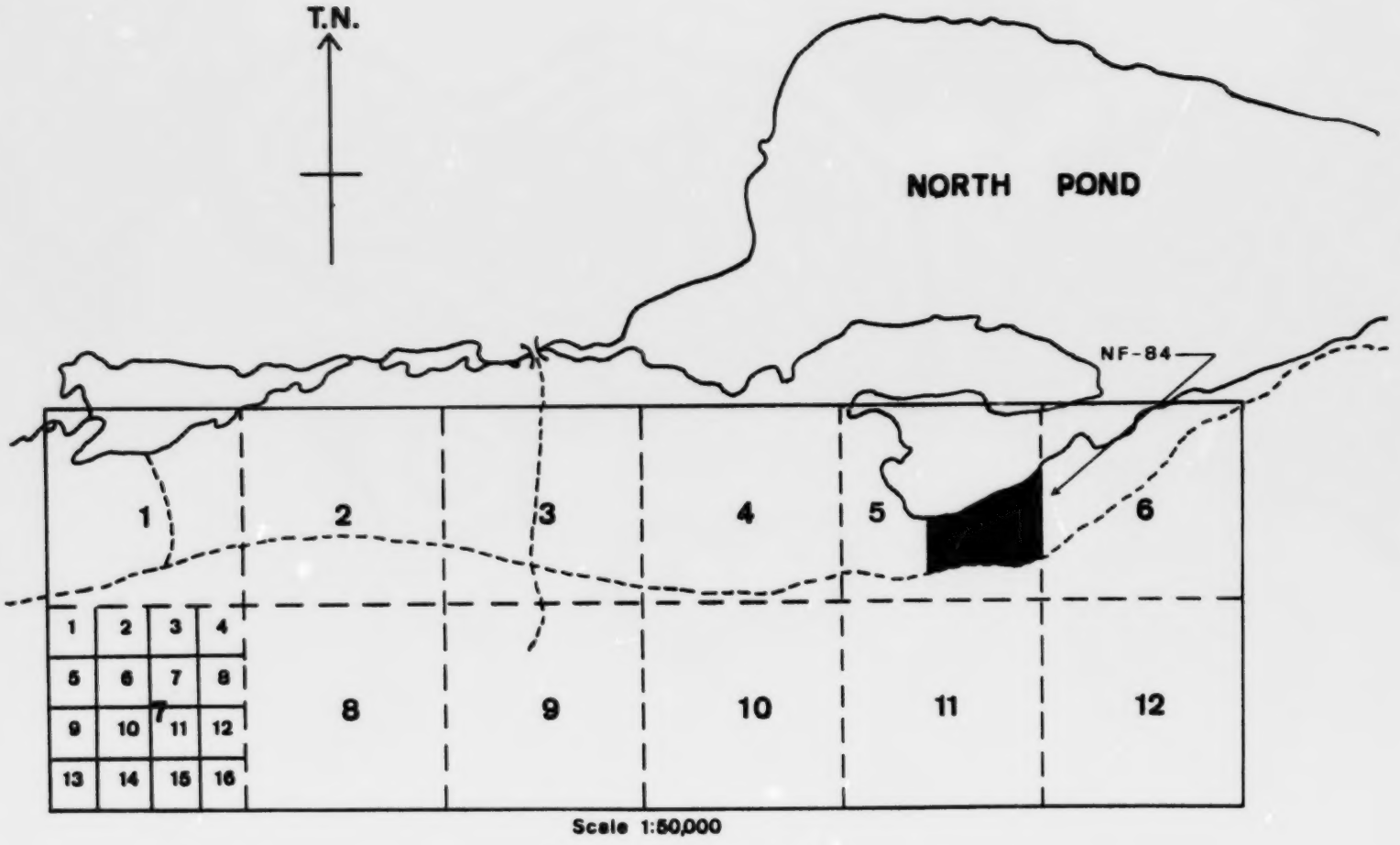
NF-84 - AERIAL SEEDING

A large-scale trial of helicopter broadcast seeding without site preparation to regenerate non-reproducing burned cutover, with a mixture of black spruce and jack pine seed.

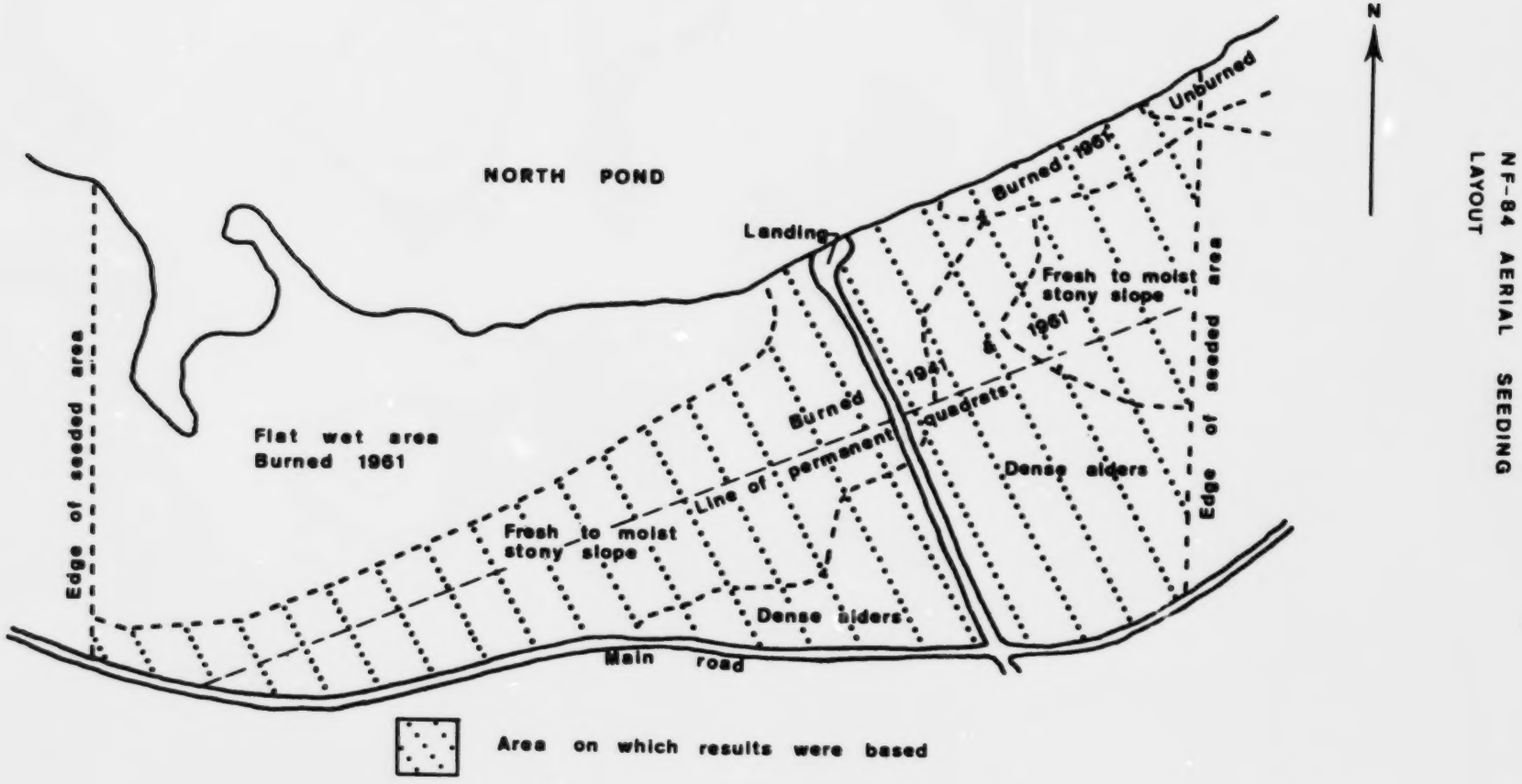
Site. Original black spruce stand was burned by wildfire in 1941, then salvage cut for pulpwood in late 1940's. Area was burned again by wildfire in 1961 which destroyed natural regeneration and left the very stony till soil of the drier parts of the area almost without organic soil covering. Gentle north slope to shore of North Pond. Flat wet areas predominate near pond, otherwise soil moisture conditions vary from fresh to moist. Since 1961 fire, alders have aggressively colonized upper slopes, aspen is common on other slope sites over a moss carpet. Stunted black spruce, alders and sphagnum moss are dominant vegetation on the lower flat wet area. At time of seeding, some natural black spruce regeneration was present. (Site Type 4, p. 8)

Design. Entire area of about 50 ha (0.4 x 1.2 km) was seeded in 24 m wide N-S strips by helicopter fitted with Brohm seeder.
A mixture of black spruce (central Newfoundland origin, 80 percent viable) and jack pine (northern Ontario, 98 percent viable) was seeded at an estimated rate of 79,000 black spruce and 10,400 jack pine seed per hectare.
A line of 32 permanent 4 m^2 quadrats was established across the seeded area and all natural spruce seedlings were removed from these plots.

History. Seeding carried out in late April 1965.
Seedling counts made on permanent quadrats spring and fall 1965-70.
Detailed survey (stocking, seedling density, height growth, site conditions) spring 1970 at 1.2 percent sampling intensity.
Remeasured for same criteria August 1978 at 0.1 percent sampling intensity.
Cleaned and jack pine thinned in strips 20 m wide, summer 1983.



NF-84 AERIAL SEEDING
LOCATION



NF-84 AERIAL SEEDING LAYOUT

NF-84 - AERIAL SEEDING

Five-year-old jack pine seedlings 1.2 m tall on dry-fresh site.

Browsing damage on nine-year-old black spruce in area of dense alders.

NF-84 - AERIAL SEEDING

Results

Stocking and height growth:

Species	Soil Moisture Regime: Fresh 1970	Fresh 1978	Moist 1970	Moist 1978	Wet 1970	Wet 1978	All sites 1970	All sites 1978
1) Percent stocking								
Black spruce*	71	90	75	89	37	81	67	90
Jack pine	59	69	60	36	16	10	52	50
Alder		69		56		81		61
Aspen		74		14		0		42
Willow		48		25		0		32
2) Average height (m)								
Black spruce*	0.21	1.61	0.20	1.39	0.19	0.80	0.20	1.22
Jack pine	0.38	2.93	0.35	1.30	0.24	0.46	0.35	2.38
Alder		2.26		2.42		1.26		1.88
Aspen		2.80		2.10				2.40
Willow		1.93		1.55				1.52

Seedling density:

Species	Stems/ha 1970	Stems/ha 1978
Black spruce*	12 000	13 800
Jack pine	3 600	3 000
Alder		15 800
Aspen		4 400
Willow		2 200
White birch		1 000

Influence of alders on height growth:

Species	Alder	Average Height of Tallest Seedling Per Quadrat (m): Fresh sites 1970	Fresh sites 1978	Moist sites 1970	Moist sites 1978	Wet sites 1970	Wet sites 1978
Black spruce*	Present	0.25	1.75	0.24	1.91	0.18	0.86
	Absent	0.18	1.26	0.17	1.00	0.20	0.52
Jack pine	Present	0.44	3.04	0.34	1.83	0.24	0.46
	Absent	0.32	2.75	0.35	0.98	0.22	-

*All black spruce data includes natural regeneration as well as seeded trees.

NF-84 - AERIAL SEEDING

Assessment of Results

Aerial seeding at intensities used produced adequate stocking of black spruce and jack pine on fresh to moist sites. Jack pine seedling density is high for broadcast seeding on an unscarified site (c. 30 percent field germination).

Between 1970 and 1978, black spruce stocking and density increased due to seeding in from cones on natural regeneration and unburned mature trees on wet sites; jack pine stocking and density increased on fresh sites due to natural seeding in from cones on seeded trees, but decreased on moist and wet sites due to mortality.

Jack pine height growth is best on fresh sites where it competes well with aspen and alder; on wetter sites, intense hardwood competition and increased soil moisture have not permitted good growth of pine. Black spruce growth is also best on fresh sites, but spruce seedlings are overtopped by hardwoods on all sites.

Despite the element of competition, evidence exists of enhanced softwood growth in quadrats where alders are present. This may be related to fixation of atmospheric nitrogen by alder root nodules.

Reports and Publications

Richardson, J. 1973. Aerial seeding after wildfire in central Newfoundland. Environ. Can., Forest. Serv., Information Report N-X-84. 23 p.

NF-85 - BROADCAST SEEDING BLACK SPRUCE

A large-scale trial of ground broadcast seeding without site preparation to regenerate non-reproducing cut and burned areas, comparing two seeding rates with an unseeded control.

Site. Original stand of black spruce-balsam fir with scattered white birch was cut for pulpwood in 1957, then area was burned by wildfire in 1961. Gentle to moderate north slope on fresh to wet, chiefly moist, moderately stony, till soils. Vegetation consists mainly of moss carpet with low herbs or Kalmia and natural regeneration of white birch, aspen and pin cherry. In wetter areas, grass and sedge predominate with frequent vigorous alder clumps. (Chiefly Site Type 1, p. 8)

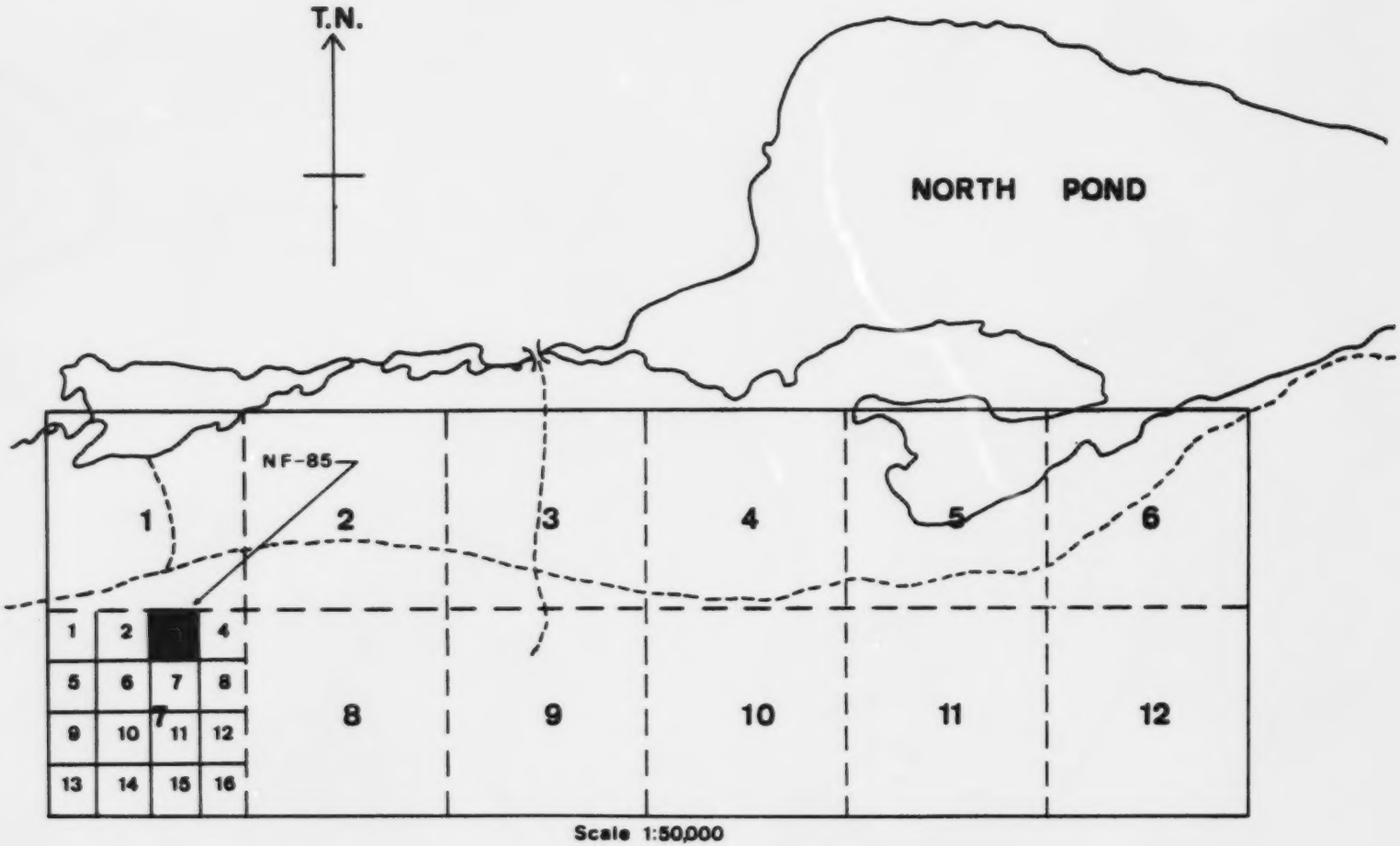
Design. Randomized complete block with seven replications of each of three treatments:

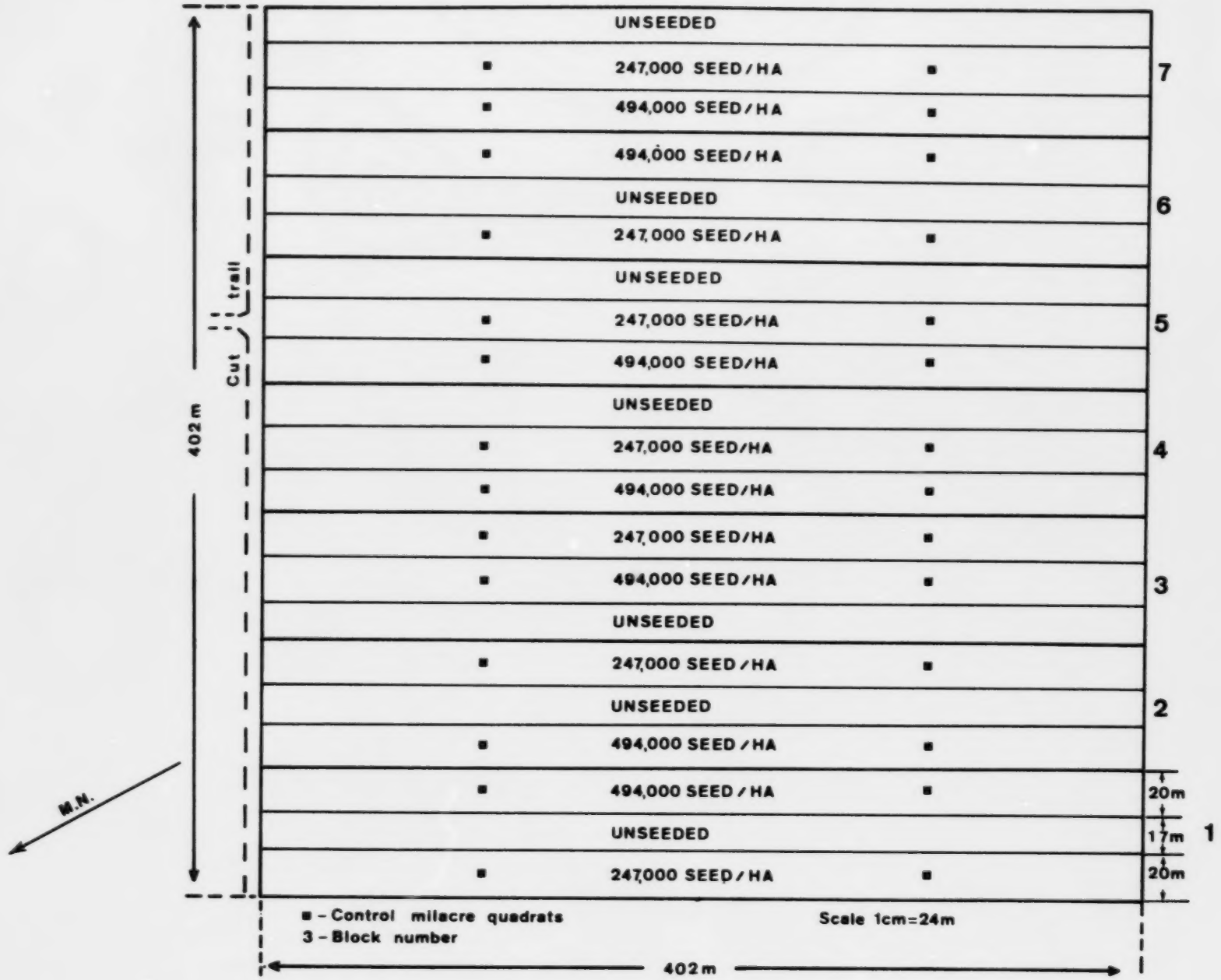
a) seeding at 247 000 seed/ha, b) seeding at 494 000 seed/ha,
c) no seeding.

Seeded with hand-operated Cyclone seeders, using black spruce seed of central Newfoundland origin, 85 percent viable.
Each treatment plot is a strip 20 m wide (17 m if unseeded) and 402 m long.
Total area of experiment is 16.2 ha (402 m x 402 m).
Two permanent 4 m^2 quadrats were established in each seeded plot (a total of 28 quadrats).

History. Established November 1963.
Seedling counts made on permanent quadrats spring and fall 1964-67.
More detailed survey (stocking, seedling density, site conditions) July 1968 at 4.2 percent sampling intensity.
Remeasured (stocking, seedling density, height growth) August 1978 at 0.5 percent sampling intensity.
Access improved and posts re-established on north boundary, summer 1983.

NF-85 BROADCAST SEEDING BLACK SPRUCE
LOCATION





NF-85 BROADCAST SEEDING BLACK SPRUCE
LAYOUT

NF-85 - BROADCAST SEEDING BLACK SPRUCE

General view of seeded strip (on left) 10 years after seeding, June 1973.

General view of 15 year old seeded black spruce, March 1979.

NF-85 - BROADCAST SEEDING BLACK SPRUCE

Results

Black spruce stocking and seedling density:

Treatment	Percent stocking		Seedlings per ha	
	1968	1978	1968	1978
No seeding	17.5	31.4	960	1 380
247 000 seed per ha	80.5	98.6	8 900	15 560
494 000 seed per ha	83.8	91.4	13 540	19 230

Stocking, density and height of tree species in 1978, all plots:

Species	Percent stocking	Seedlings per ha	Average height (m)
Black spruce	73.8	12 060	1.55
Balsam fir	1.0	50	1.19
White birch	69.5	13 420	1.50
Pin cherry	57.1	6 550	0.72
Willow	56.7	4 580	1.39
Trembling aspen	41.4	2 550	1.22
Alder	12.4	3 860	2.21
Elderberry	3.3	180	0.36
Mountain ash	1.0	110	0.83
All hardwoods	98.6	31 240	1.26

NF-85 - BROADCAST SEEDING BLACK SPRUCE

Assessment of Results

Black spruce can be broadcast seeded successfully on these sites without site preparation.

Both seeding rates gave more than adequate stocking. Somewhat less than the lower rate should be sufficient on receptive sites.

Black spruce stocking and seedling density increased between 1968 and 1978 presumably due to seeding in from cones on both the naturally regenerated and the seeded black spruce.

Best stocking occurred on fresh to wet sites with moss carpet and herbaceous ground cover. It was less on wet sites with alders and on fresh sites with a dry matted organic layer and Kalmia cover.

Hardwood regeneration now greatly outnumbers softwood regeneration on this site, but, with the exception of alders occurring in clumps on wet spots, black spruce is still the tallest tree species.

Reports and Publications

Wilton, W.C. 1964. Establishment report. Broadcast seeding a 1961 burn by Cyclone seeder using two intensities of black spruce. Project NF-85, Can. Dep. Forest., Forest. Res. Br., St. John's, Nfld. Unpublished mimeogr.

Richardson, J. 1970. Broadcast seeding black spruce on a burned cutover. Can. Dep. Fish. & Forest., Can. Forest. Serv., Publ. 1272. 14 p.

NF-98 - BLACK SPRUCE BROADCAST SEEDING ON ROME DISCER SCARIFICATION

A large-scale test of Rome discer scarification as a means of preparing burned cutover sites for ground broadcast seeding of black spruce. Scarified and unscarified, seeded and unseeded treatments are compared in all combinations on a range of site conditions.

Site. There are four widely separated areas; all were at least partially cutover for pulpwood in 1957-58, prior to burning in the 1961 fire.

Area 1 - fresh to moist gentle north slope, thin organic layer, moss carpet with some herbs and aspen and pin cherry regeneration. Site Type 1 (p. 8).

Area 2 - fresh to moist gentle to moderate north slope with some wet areas, thin organic layer over stony soil, moss carpet with grass and sedge and birch regeneration, alders in wet areas. Site Types 1 and 2 (p. 8).

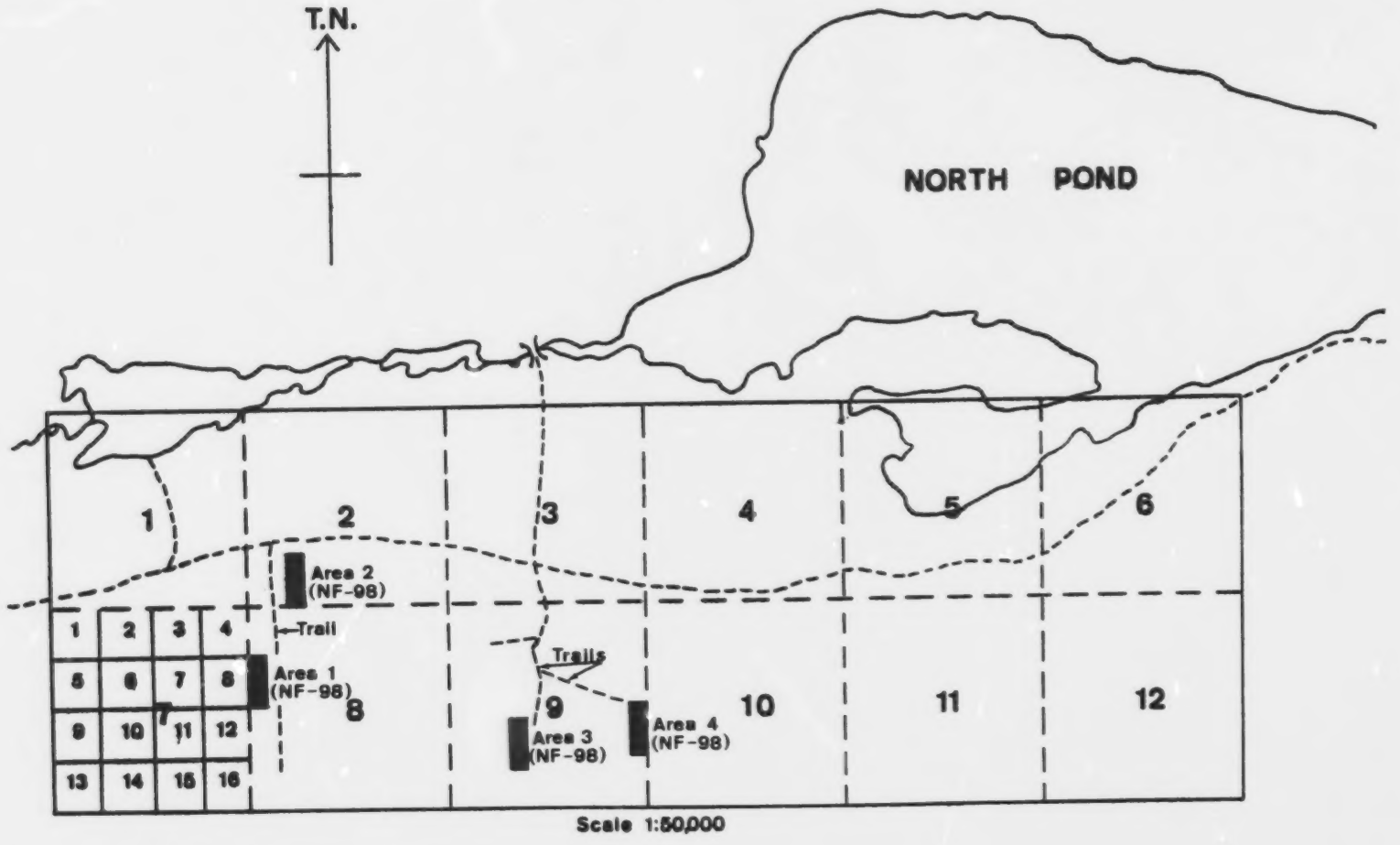
Area 3 - previous black spruce stand largely uncut, moist to wet gentle to moderate north slope, moderately deep organic layer, ericaceous dwarf shrub cover and black spruce regeneration. Site Type 6 (p. 9).

Area 4 - fresh to moist gentle north and south slopes, fairly thin organic layer, ericaceous dwarf shrub cover and aspen and black spruce regeneration. Site Type 6 (p. 9).

Design. Systematic arrangement of treatments in each area.
Half of each area scarified by Rome discer towed by D-6 tractor (tractor blade used in part of Area 3).
Areas divided into treatment plots and seeded or left unseeded in checker-board fashion.
Broadcast seeding by Cyclone seeder with 247 000 viable black spruce seed/ha of central Newfoundland origin.
Two permanent quadrats (4 m^2 each) cleared of natural spruce and seeded by hand at same rate.
Forty treatment plots, each 0.2 ha, in each area - total 8 ha.
Total area of experiment 32 ha.

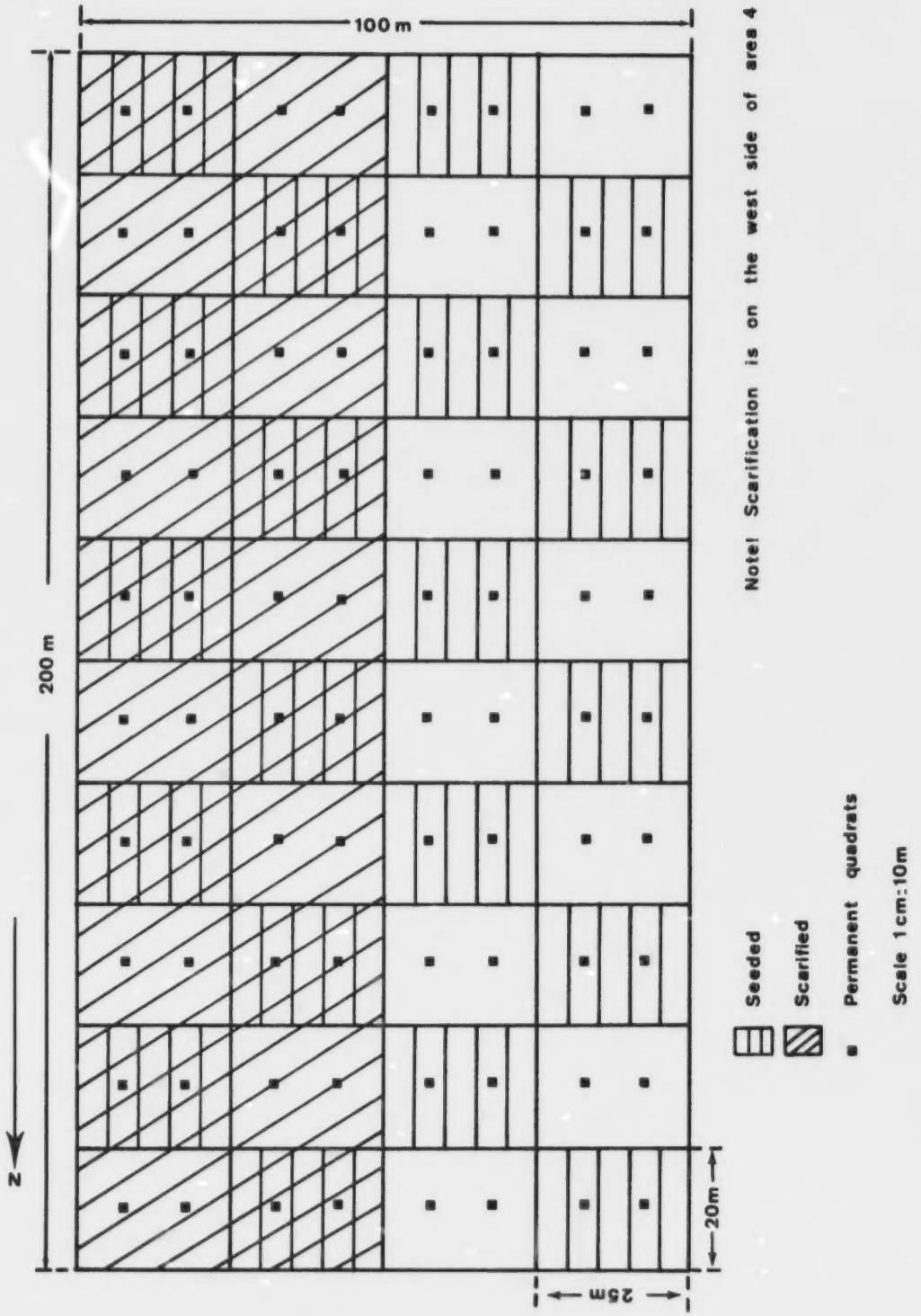
History. Scarified October 1964.
Seeded November 1964.
Remeasured July 1969 on 4 percent sample basis.
Remeasured again on 0.5 percent sample basis June 1979.
Access to Areas 1 and 2 improved, major boundary lines and posts re-established, summer 1983.

NF-98 BLACK SPRUCE BROADCAST SEEDING ON ROME DISCER SCARIFICATION
LOCATION



Scale 1:50,000

NF-98 BLACK SPRUCE BROADCAST SEEDING ON ROME DISCER SCARIFICATION LAYOUT



NF-98 - BLACK SPRUCE BROADCAST SEEDING ON ROME DISCER SCARIFICATION

Cherry and birch natural regeneration in Area 1, June 1969.

Seeded black spruce in Area 1 (seeded block on right), March 1979.

NF-98 - BLACK SPRUCE BROADCAST SEEDING ON ROME DISCER SCARIFICATION

Results

Percent stocking black spruce:

	Scarified						Unscarified											
	Seeded		Unseeded		Average		Seeded		Unseeded		Average		Seeded		Unseeded		Average	
Area	69	79	69	79	69	79	69	79	69	79	69	79	69	79	69	79	69	79
1	74	88	27	44	50	66	58	84	30	28	44	56	66	86	28	36	47	61
2	67	84	16	12	41	48	54	72	37	32	46	52	61	60	26	22	44	50
3	66	92	48	72	57	82	52	52	63	52	58	52	59	72	56	62	58	67
4	76	76	56	56	66	66	87	72	82	88	84	80	82	74	69	72	75	73
Average	71	85	37	46	54	66	63	70	53	50	58	60	67	73	45	48	56	63

Black spruce seedling density (stems/ha x 1000):

	Scarified						Unscarified											
	Seeded		Unseeded		Average		Seeded		Unseeded		Average		Seeded		Unseeded		Average	
Area	69	79	69	79	69	79	69	79	69	79	69	79	69	79	69	79	69	79
1	10.9	15.5	1.5	2.7	6.2	9.1	4.4	7.5	1.2	0.8	2.8	4.2	7.7	11.5	1.5	1.8	4.4	6.7
2	10.1	9.7	1.0	0.4	5.6	5.0	5.4	6.9	2.2	1.0	3.8	4.0	7.9	8.3	1.6	0.7	4.7	4.5
3	14.8	12.8	5.7	7.0	10.2	9.9	5.2	4.9	9.9	2.8	7.6	3.8	10.1	8.8	7.7	4.9	8.9	6.8
4	9.6	8.5	6.9	2.4	8.4	5.4	28.9	8.3	29.4	11.6	29.2	10.0	19.3	8.4	18.0	7.0	18.8	7.7
Avg.	11.4	11.6	3.8	3.1	7.6	7.4	11.0	6.9	10.7	4.0	10.8	5.5	11.2	9.2	7.2	3.6	9.2	6.4

Black spruce seedling height 1979 (cm):

	Scarified			Unscarified					
Area	Seeded	Unseeded	Average	Seeded	Unseeded	Average	Seeded	Unseeded	Average
1	132	198	154	154	147	153	143	178	153
2	153	196	158	151	200	166	152	199	162
3	68	116	89	72	40	56	69	84	76
4	90	95	92	173	155	163	130	131	131
Average	110	134	119	143	131	138	125	133	128

NF-98 - BLACK SPRUCE BROADCAST SEEDING ON ROME DISCER SCARIFICATION

Assessment of Results

Broadcast seeding had little or no effect on black spruce stocking and seedling density except in Areas 1 and 2 where natural stocking of black spruce was low.

Rome disc scarification preceding seeding resulted in improved black spruce stocking and seedling densities compared to no scarification in Areas 1, 2 and 3. Scarification destroyed many natural seedlings on Areas 3 and 4.

Between 1969 and 1979 remeasurements, black spruce stocking appeared to increase generally, but seedling density decreased on average.

Average black spruce seedling heights as measured in 1979 tended to be greater on unseeded plots than on seeded plots since unseeded plots contained only natural seedlings originating after the 1961 fire rather than from seeding in 1964. Growth was best on the more nutrient-rich sites - Areas 1 and 2 and the unscarified part of Area 4.

Reports and Publications

Wilton, W.C. and J. Richardson. 1965. Establishment report. Broadcast seeding a 1961 burn by Cyclone seeder following ground scarification. Can. Dep. Forest., Forest Res. Br., Mimeo 65-N-2. 14 p.

Richardson, J. 1970. Broadcast seeding a burned cutover after light scarification. Can. Dep. Fish. & Forest., Can. Forest. Serv., Information Report N-X-58. 21 p.

6-S-66 - BLACK SPRUCE SEEDSPOTTING ON SFI SCARIFICATION

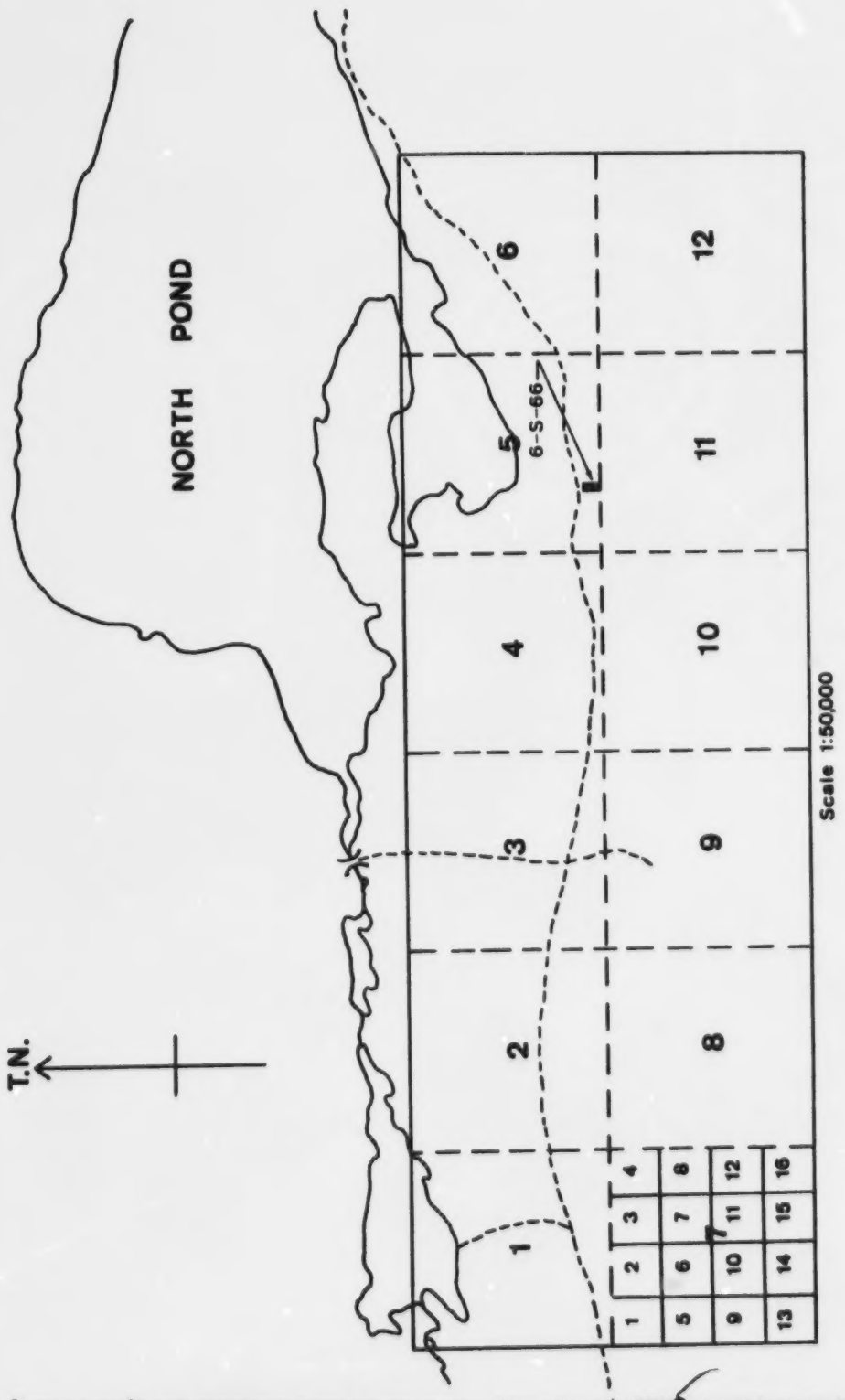
A small-scale trial of seedspotting black spruce on dry heathland prepared by SFI scarification. The experiment was designed to compare two seeding seasons and three seeding microsites on the scalps produced by the SFI.

Site. Gently sloping morainic mound with freely draining sandy soils with thin organic layer. It is doubtful if the area ever supported merchantable forests even before wildfire in 1941. Ground cover is dominated by lichen and ericaceous dwarf shrubs. Scattered low shrubby black spruce. Site Type 5 (p. 9).

Design. Latin square with factorial arrangement of treatments and six replications.
Treatments are two seeding dates (fall and spring) and three microsites (bottom, middle and top of SFI scalp) in all combinations.
Ten seedspots, each with 10 viable black spruce seed (Badger, central Newfoundland origin), sown in each treatment plot at approximately 1.8 m spacing and marked by red-painted wire pickets.
Thirty-six plots, each 33 m^2 - total area of experiment 0.12 ha.

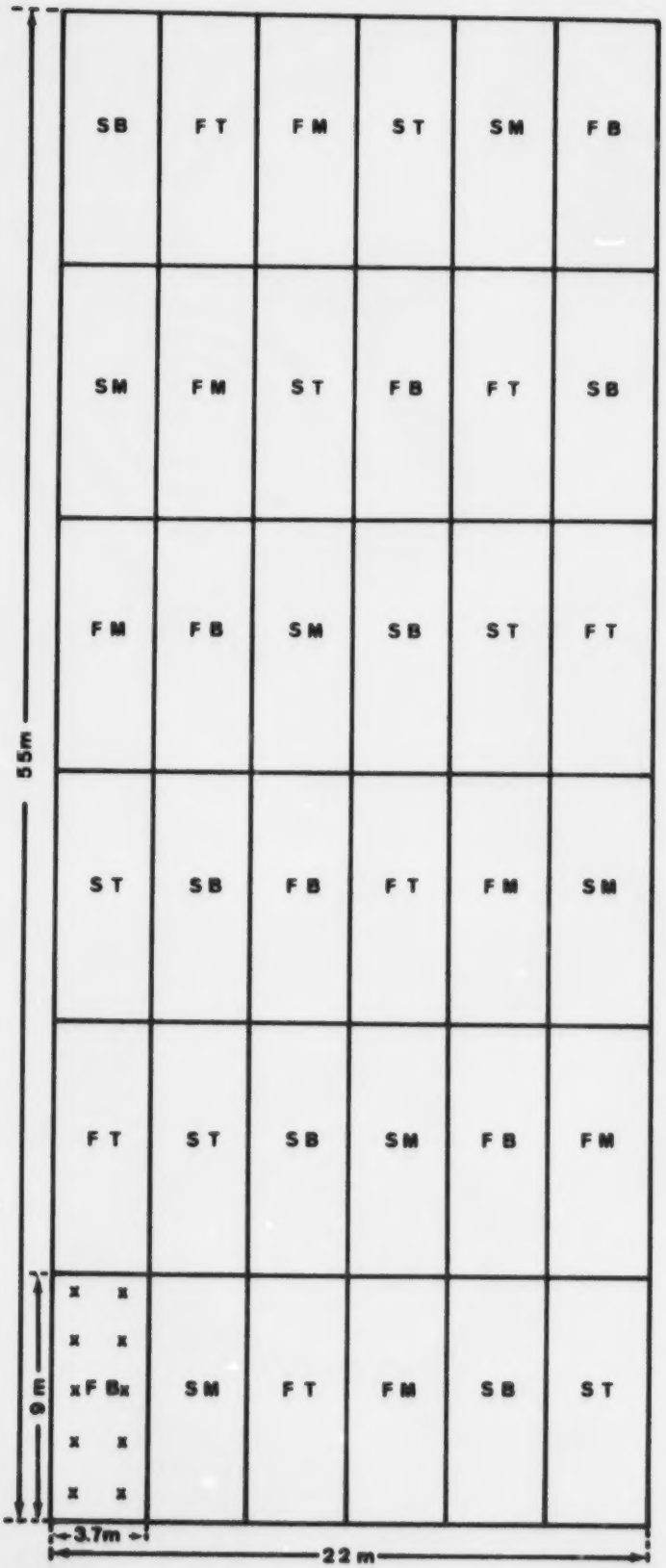
History: Scarified August 1966.
Seeded October 1966 and June 1967.
Stocking recorded fall 1967, spring and fall 1968, spring 1969.
Stocking, seedling density and growth measured June 1970.
Stocking, seedling density and growth of 17 percent of seedspots remeasured June 1979.

6-S-66 BLACK SPRUCE SEEDSPOTTING ON S.F.I. SCARIFICATION LOCATION



6-S-66 BLACK SPRUCE SEEDSPOTTING ON S.F.I. SCARIFICATION

LAYOUT



LEDGEND

FB - Bottom
FM - Middle
FT - Top
} Fall sowing positions

SB - Bottom
SM - Middle
ST - Top
} Spring sowing positions

x - Seedspot

Scale 1:240

N

6-S-66 - BLACK SPRUCE SEEDSPOTTING ON SFI SCARIFICATION

General view of barren heathland site of experiment.

12-year-old black spruce seedlings seedspotted on bottom position on SFI scalp (c. 30 cm tall).

6-S-66 - BLACK SPRUCE SEEDSPOTTING ON SFI SCARIFICATION

Results

Black spruce seedspot stocking and seedling density:

Sowing season	Microsite	Seedspot Stocking (Percent)			No. of Seedlings /Stocked Spot	
		Sept 1967	June 1970	June 1979*	June 1970	June 1979*
Fall	Scalp bottom	68	55	60	2.7	3.7
	Scalp middle	37	48	30	4.1	2.3
	Scalp top	3	8	0	1.2	0
	All sites	36	37	30	3.2	3.0
Spring	Scalp bottom	20	10	0	2.8	0
	Scalp middle	2	7	0	1.2	0
	Scalp top	5	2	0	9.0	0
	All sites	9	6	0	2.8	0
Both seasons	Scalp bottom	44	32	30	2.7	3.7
	Scalp middle	20	28	15	3.7	2.3
	Scalp top	4	5	0	2.3	0

Black spruce seedling growth:

Sowing season	Microsite	Av. Height Tallest Seedling/ Stocked Spot (cm)	
		June 1970	June 1979*
Fall	Scalp bottom	6.4	24.2
	Scalp middle	5.1	12.1
	Scalp top	4.3	-
	All sites	5.7	20.2
Spring	Scalp bottom	6.1	-
	Scalp middle	2.5	-
	Scalp top	2.5	-
	All sites	4.5	-
Both seasons	Scalp bottom	6.4	24.2
	Scalp middle	4.8	12.1
	Scalp top	4.0	20.2

*Partial remeasurements.

6-S-66 - BLACK SPRUCE SEEDSPOTTING ON SFI SCARIFICATION

Assessment of Results

Seedspotting black spruce on SFI-scarified scalps on this dry heathland site was only successful when the seedspots were sown on bottom microsites on the scalp in the fall. Seedspotting on middle microsites in the fall achieved somewhat less success. Seedspotting on top microsites and in the spring was a complete failure. Seedspot failure was attributed to exposure and inadequate soil moisture.

Height growth of all seedlings has been poor due to lack of soil moisture and available nutrients.

Reports and Publications

Richardson, J. 1971. Seedspotting black spruce on scarified scalps. Can. Dep. Environ., Can. Forest. Serv., Information Report N-X-66. 12 p.

1-S-67 - COMPARISON OF SEEDING METHODS ON SFI SCARIFICATION

A large-scale comparison of ground broadcast seeding and seedspotting (and no seeding), using black spruce, on two different burned cutover sites prepared by SFI scarification and unscarified.

Site. There are two widely separated areas, both were cutover for pulpwood about 1959, prior to burning in the 1961 fire.

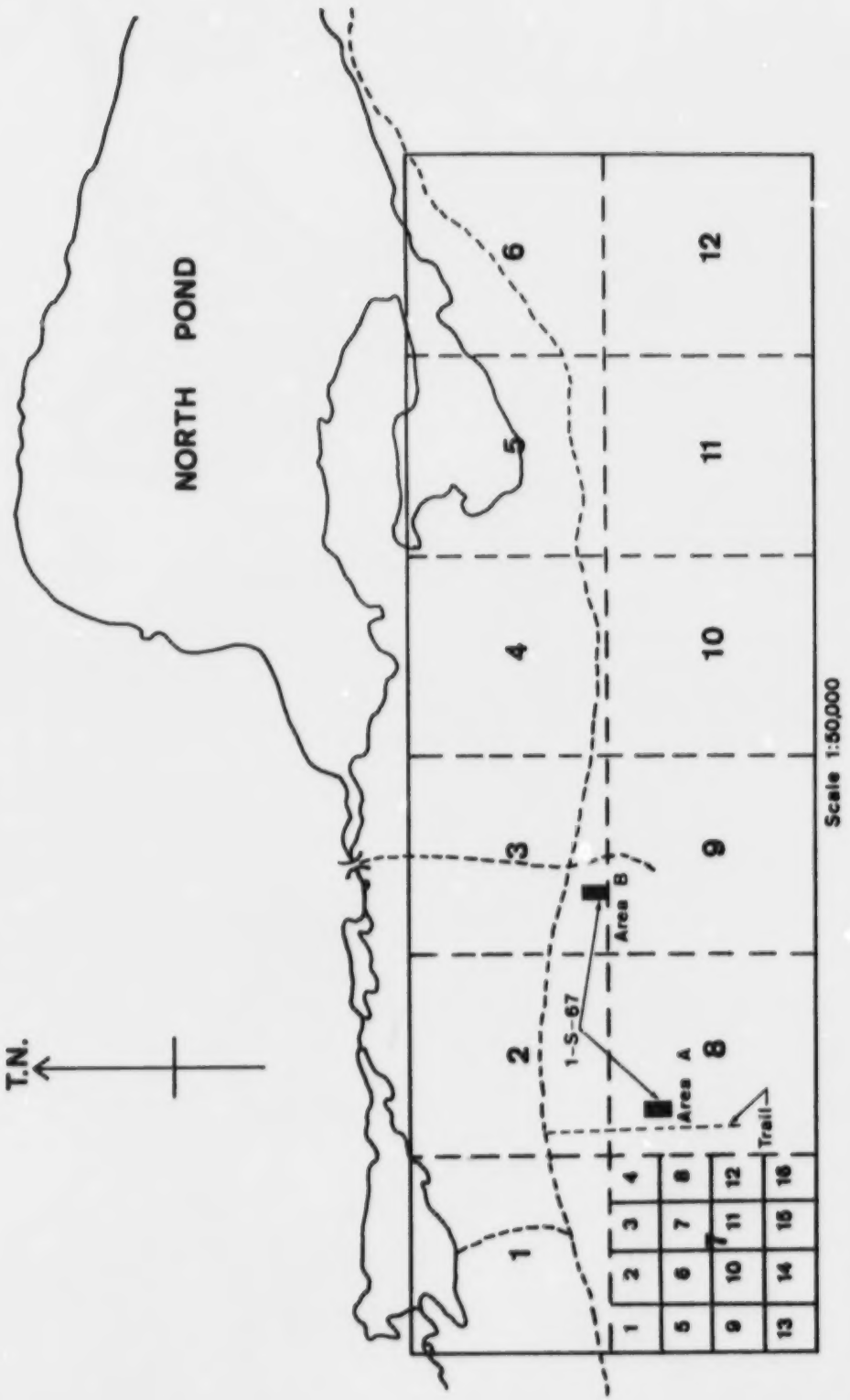
Area A - fresh to moist gentle north slope; original stands balsam fir, white birch and aspen; thin organic layer; moss carpet with some herbs and pin cherry, white birch and aspen reproduction. Site Type 1 (p. 8).

Area B - fresh to moist gentle north slope near crest of low ridge; original stand black spruce with scattered birch, aspen and white pine; deep organic layer; ericaceous dwarf shrub cover with some moss, lichens and herbs; black spruce regeneration and some alder patches. Site Type 6 (p. 9).

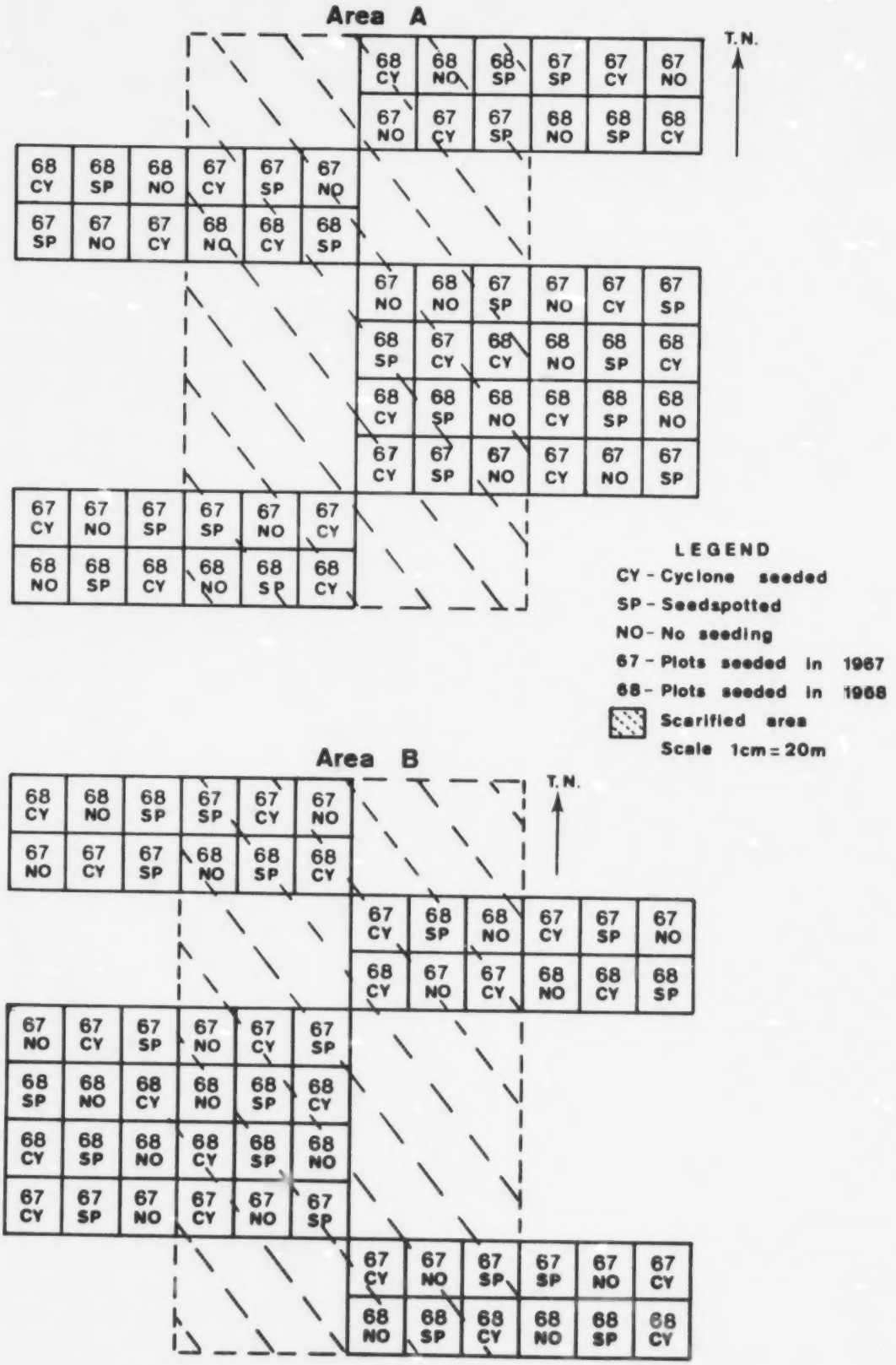
Design. Randomized complete block design with split-split plot arrangement of treatments in each area.
Five replications of whole-plot treatments (61 m x 41 m) - scarified and unscarified.
Split-plot treatments (61 m x 20 m) - seeded 1967 and seeded 1968.
Split-split-plot treatments (20 m x 20 m) - broadcast seeded (cyclone seeders) 124 000 viable black spruce/ha (central Newfoundland origin); seedspotted, 15 viable seed/spot on scalps at 1.8 m spacing; unseeded.
Results assessed only on 14 m x 14 m area within each plot.
Sixty plots, each 400 m^2, in each area - total 2.4 ha.
Total area of experiment 4.8 ha.

History. Scarified August 1966.
Natural black spruce reproduction removed from plots to be seeded August 1967.
Seeded October 1967 and December 1968.
Measured stocking, density and growth on all plots fall 1972.
Remeasured stocking, density and growth on 1 percent sample basis, June, 1979.
Access improved and demonstration trail established in Area A, summer 1983.

1-S-67 COMPARISON OF SEEDING METHODS ON S.F.I. SCARIFICATION LOCATION



1-S-67 COMPARISON OF SEEDING METHODS ON S.F.I. SCARIFICATION LAYOUT


Area A
T.N.
68 CY | 68 NO | 68 SP | 67 SP | 67 CY | 67 NO
67 NO | 67 CY | 67 SP | 68 NO | 68 SP | 68 CY
68 CY | 68 SP | 68 NO | 67 CY | 67 SP | 67 NO
67 SP | 67 NO | 67 CY | 68 NO | 68 CY | 68 SP
67 NO | 68 NO | 67 SP | 67 NO | 67 CY | 67 SP
68 SP | 67 CY | 68 CY | 68 NO | 68 SP | 68 CY
68 CY | 68 SP | 68 NO | 68 CY | 68 SP | 68 NO
67 CY | 67 SP | 67 NO | 67 CY | 67 NO | 67 SP
67 CY | 67 NO | 67 SP | 67 SP | 67 NO | 67 CY
68 NO | 68 SP | 68 CY | 68 NO | 68 SP | 68 CY
LEGEND
CY - Cyclone seeded
SP - Seedspotted
NO - No seeding
67 - Plots seeded in 1967
68 - Plots seeded in 1968
Scarified area
Scale 1cm = 20m
Area B
T.N.
68 CY | 68 NO | 68 SP | 67 SP | 67 CY | 67 NO
67 NO | 67 CY | 67 SP | 68 NO | 68 SP | 68 CY
67 CY | 68 SP | 68 NO | 67 CY | 67 SP | 67 NO
68 CY | 67 NO | 67 CY | 68 NO | 68 CY | 68 SP
67 NO | 67 CY | 67 SP | 67 NO | 67 CY | 67 SP
68 SP | 68 NO | 68 CY | 68 NO | 68 SP | 68 CY
68 CY | 68 SP | 68 NO | 68 CY | 68 SP | 68 NO
67 CY | 67 SP | 67 NO | 67 CY | 67 NO | 67 SP
67 CY | 67 NO | 67 SP | 67 SP | 67 NO | 67 CY
68 NO | 68 SP | 68 CY | 68 NO | 68 SP | 68 CY

1-S-67 - COMPARISON OF SEEDING METHODS ON SFI SCARIFICATION

Black spruce seedspot in Area A,
October 1972

Broadcast seeded black spruce in Area A,
October 1972

1-S-67 - COMPARISON OF SEEDING METHODS ON SFI SCARIFICATION

Results

Black spruce percent stocking and seedling density:

Site treatment	Treatment year	Percent Stocking: Broadcast 1972	Broadcast 1979*	Seedspot 1972	Seedspot 1979*	Unseeded 1972	Unseeded 1979*	Seedling Density (Stems/ha x 1000): Broadcast 1972	Broadcast 1979*	Seedspot 1972	Seedspot 1979*	Unseeded 1972	Unseeded 1979*
Area A													
Scarified	1967	87	100	42	100	16	40	11.1	19.3	4.8	7.9	0.4	1.0
	1968	79	100	33	40	18	20	6.5	9.4	2.1	2.0	0.6	0.5
Un-	1967	78	80	46	80	20	0	9.1	9.9	5.0	11.4	0.7	0
scarified	1968	69	60	40	100	25	20	4.1	4.0	2.1	8.4	0.8	0.5
Area B													
Scarified	1967	51	60	15	20	37	20	3.6	3.0	1.7	0.5	2.1	0.5
	1968	30	60	16	0	50	40	1.6	1.5	1.4	0	3.8	1.0
Un-	1967	30	60	19	40	45	60	1.9	6.4	2.0	1.0	5.5	2.5
scarified	1968	30	40	11	0	47	80	2.0	1.0	0.4	0	3.4	5.4

Black spruce seedling height (tallest seedling/quadrat or seedspot) (cm):

Site treatment	Treatment year	Broadcast seeded 1972	Broadcast seeded 1979*	Seedspotted 1972	Seedspotted 1979*	Unseeded 1972	Unseeded 1979*
Area A							
Scarified	1967	31	125	32	152	62	60
	1968	20	97	21	58	92	288
Unscarified	1967	25	102	24	133	101	-
	1968	18	112	21	110	98	104
Area B							
Scarified	1967	21	69	15	56	66	25
	1968	15	144	13	-	69	145
Unscarified	1967	17	196	11	51	55	262
	1968	19	68	10	-	53	429

*Partial remeasurement.

1-S-67 - COMPARISON OF SEEDING METHODS ON SFI SCARIFICATION

Assessment of Results

Broadcast seeding black spruce gave much better stocking and seedling densities than seedspotting on all sites.

On Area B, where a good natural seed source was originally present, natural stocking of black spruce on unseeded plots exceeded the stocking produced by either seeding method because seedbed conditions had deteriorated since the natural seedlings became established.

SFI scarification caused only a marginal increase in black spruce stocking and destroyed natural seedlings.

Stocking, density and growth of seeded black spruce was better on Area A than Area B because of the shallower organic layer and greater availability of soil nutrients in Area A.

Seeding in 1967 produced slightly greater stocking and seedling density than seeding in 1968.

Reports and Publications

Richardson, J. and V. Chaffey. 1970. Broadcast seeding and seedspotting black spruce on scarified and unscarified ground. Can. Dep. Fish. & Forest., Can. Forest. Serv., Internal Report N-26. 8 p.

Richardson, J. 1974. A comparison of two direct seeding techniques on scarified and unscarified ground. Environ. Can., Can. Forest. Serv., Information Report N-X-107. 23 p.

66-11 - SPRUCE AND PINE BROADCAST SEEDING ON SFI-SCARIFIED BARREN

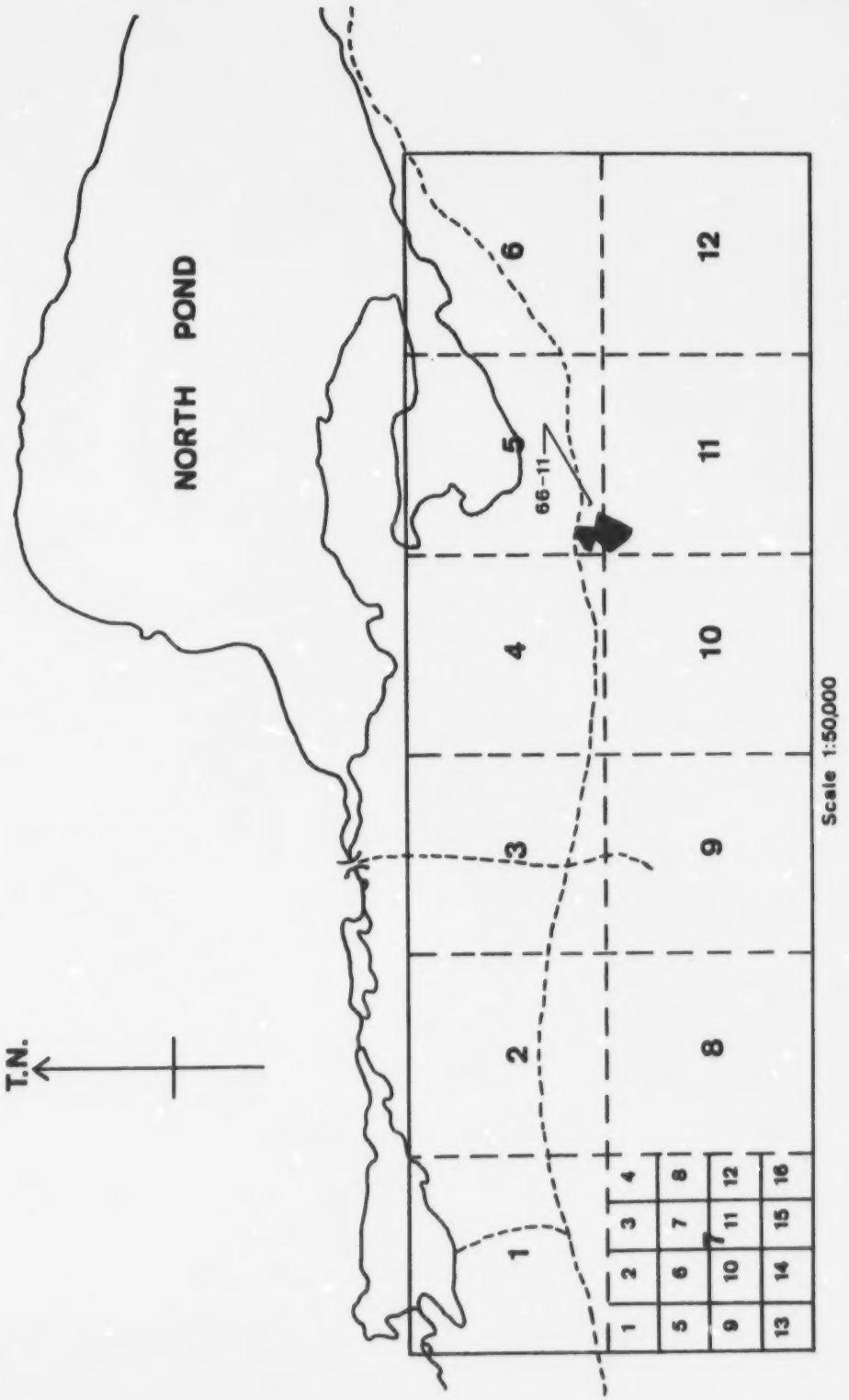
A large-scale demonstration of SFI scarification on a moist heathland site. The scarified area was subsequently broadcast seeded using Cyclone seeders with a mixture of white spruce and lodgepole pine seed in one section, and black spruce seed in another section.

Site. Moist sandy loam - clay loam soil with deep organic layer on a very gentle north slope. This site probably never supported productive forest even before the 1941 wildfire. Ground vegetation of ericaceous dwarf shrubs over lichen carpet with sphagnum moss in moister depressions. Scattered small black spruce trees. Site Type 5 (p. 9).

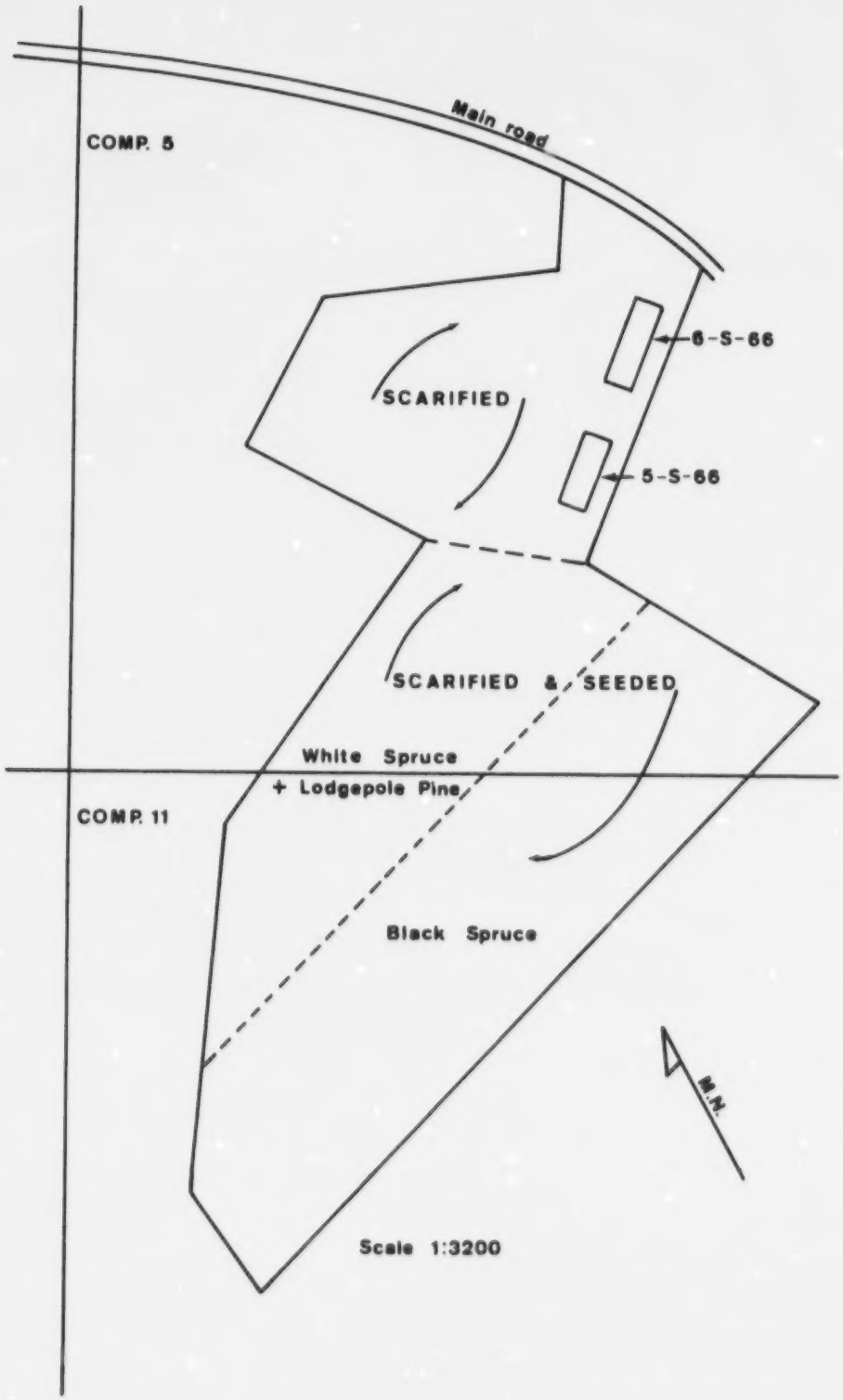
Design. Total of 8.1 ha scarified by SFI towed by wheeled skidder and producing approximately 0.23 m^2 scalps at 1.8 m spacing. Part of this area utilized by experiments 5-S-66 and 6-S-66. Of remainder, 5.9 ha block seeded on snow using hand-operated Cyclone seeders with, in one section, a mixture of 53 400 viable white spruce and 39 000 viable lodgepole pine seed/ha (both species of Clearwater, B.C. origin), and in another section, 194 800 viable black spruce seed/ha (Badger, Newfoundland origin).

History. Scarified July 1966.
Seeded March 1969.
Regeneration survey at 4 percent intensity July 1974.
Regeneration survey at 0.1 percent intensity, June 1979.

66-11 SPRUCE AND PINE BROADCAST SEEDING ON S.F.I. SCARIFIED BARREN
LOCATION



66-11 SPRUCE AND PINE BROADCAST SEEDING ON S.F.I. SCARIFIED BARREN LAYOUT



66-11 - SPRUCE AND PINE BROADCAST SEEDING ON SFI-SCARIFIED BARREN

40 cm tall lodgepole pine resulting from seeding, July 1978, 12 growing seasons after seeding.

66-11 - SPRUCE AND PINE BROADCAST SEEDING ON SFI-SCARIFIED BARREN

Results

Stocking and seedling density:

	Percent Stocking					Seedlings/ha				
	Black Spruce			Lodgepole Pine	Other sp.	Black Spruce			Lodgepole Pine	Other sp.
Date	Seeded	Natural	All	Seeded	Natural	Seeded	Natural	All	Seeded	Natural
July 1974	4	70	72	5	4	100	4 800	4 900	300	100
June 1979			92	15	0			5 100	500	

Height growth:

	Average Height (cm)	
Date	Black spruce (all)	Lodgepole pine
June 1979	41	12

66-11 - SPRUCE AND PINE BROADCAST SEEDING ON SFI-SCARIFIED BARREN

Assessment of Results

This barren heathland site permitted excellent production rates with the SFI scarifier (0.57 ha/h), but seeding was unsuccessful due perhaps to excessive soil moisture, exposure, frost heaving and lack of nutrients.

Results are somewhat confused because no attempt was made in the surveys to distinguish between the two sections seeded with different species. Thus stocking and seedling densities are calculated on the basis of the entire seeded area. However, the number of seedlings found which can be attributed to the seeding is very low throughout.

Height growth of seedlings has been very poor. Average height of black spruce measured in 1979 is based largely on natural seedlings which have presumably originated since the 1941 fire.

Reports and Publications

Nil

66-12 - BLACK SPRUCE BROADCAST SEEDING ON SFI SCARIFICATION

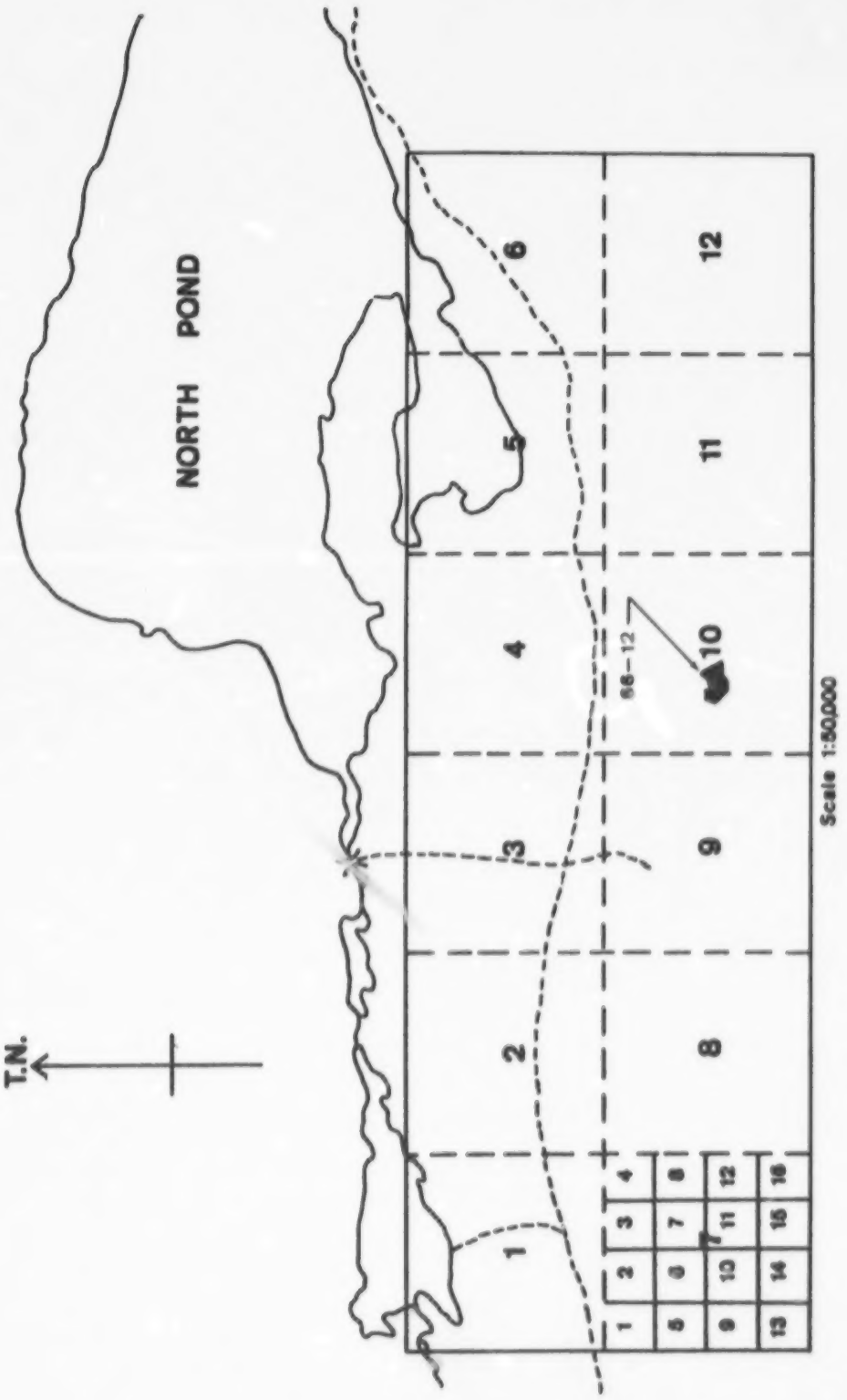
A large-scale demonstration of SFI scarification on a relatively clean burned cutover site. The area was broadcast seeded shortly after scarification; black spruce seed was applied using Cyclone seeders. This trial is similar in site and treatment to 66-13.

Site. Fresh sandy loam with few stones and scattered surface boulders, and with a fairly deep organic layer (15 cm) on a moderate north slope. The site probably originally supported productive black spruce-balsam fir stands but was burned by wildfire in 1941, may have been salvage-logged in the late 1940's, and was burned by wildfire again in 1961. Ground vegetation of ericaceous dwarf shrubs and herbs with patches of alders and scattered young aspen and black spruce stems. Site Type 7 (p. 9).

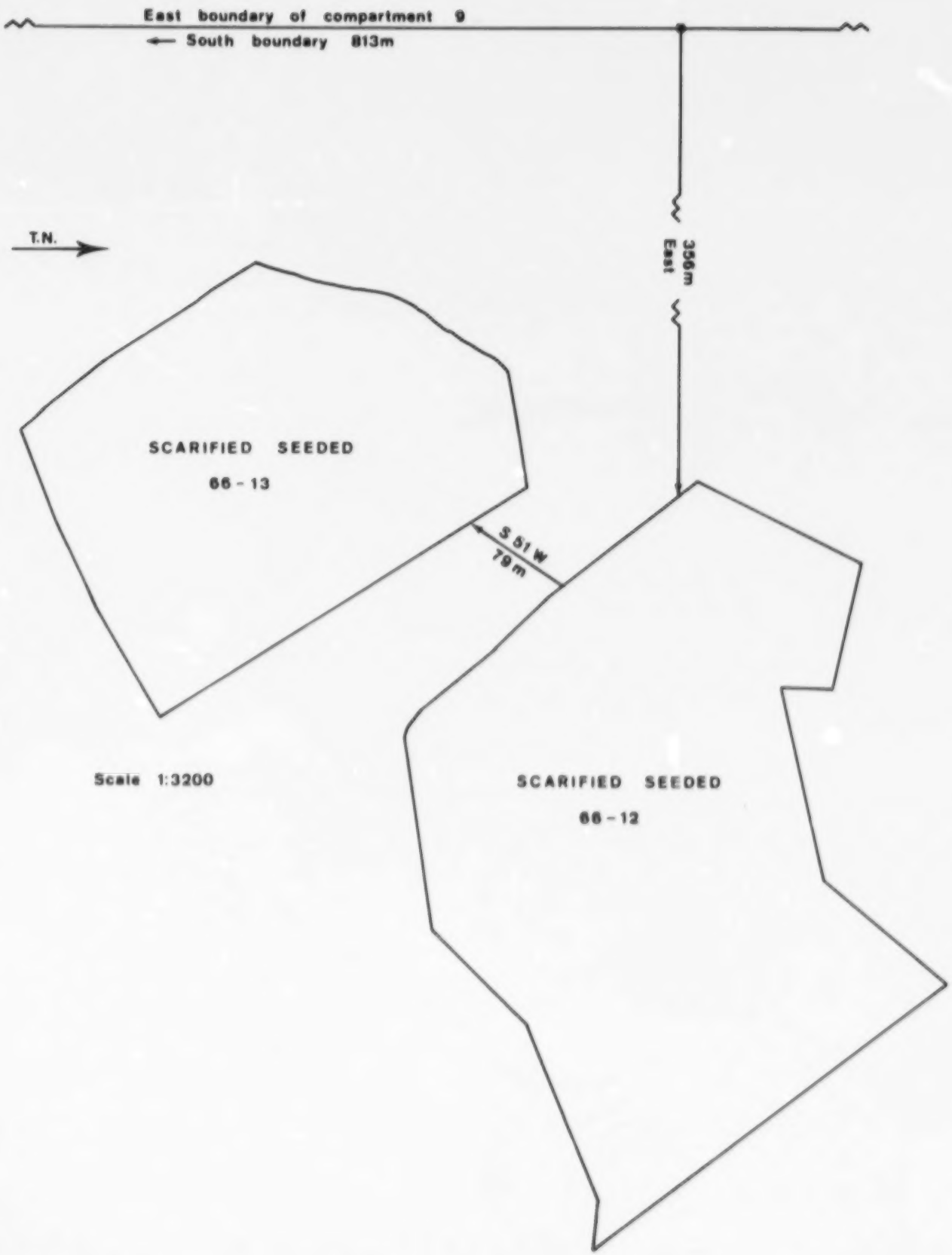
Design. Total of 8.7 ha scarified by SFI towed by wheeled skidder and producing approximately 0.23 m^2 scalps at 1.8 m spacing. Entire area broadcast seeded using hand-operated Cyclone seeders with 197 700 viable black spruce seed/ha (central Newfoundland origin).

History. Scarified July 1966.
Seeded November 1966.
Regeneration survey at 4 percent intensity August 1974.
Regeneration survey at 0.16 percent intensity June 1979.

66-12 BLACK SPRUCE BROADCAST SEEDING ON S.F.I. SCARIFICATION LOCATION



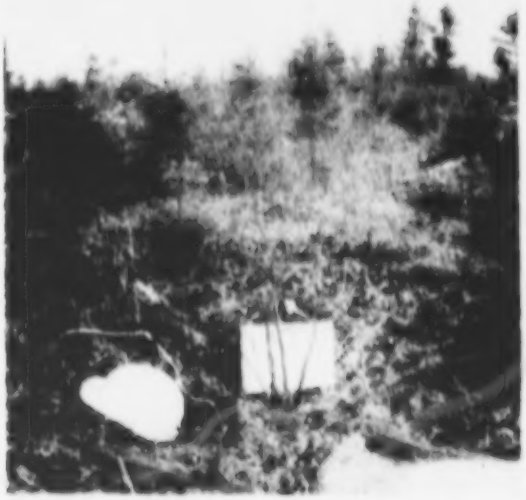
66-12 BLACK SPRUCE BROADCAST SEEDING ON S.F.I. SCARIFICATION LAYOUT



Scale 1:3200

66-12 - BLACK SPRUCE BROADCAST SEEDING ON SFI SCARIFICATION

General view of site looking towards site of Study 66-13 in background, May 1970.



Natural black spruce reproduction on site, and alder growth, May 1973.

66-12 - BLACK SPRUCE BROADCAST SEEDING ON SFI SCARIFICATION

Results

Stocking and seedling density:

Date	Percent Stocking					Seedlings/ha				
	Black spruce			Aspen	Other sp.	Black spruce			Aspen	Other sp.
	Seeded	Natural	All	Natural		Seeded	Natural	All	Natural	
August 1974	41	8	44	29	9	2000	300	2400	1600	400
June 1979			74	43	9			3500	1600	200

Height growth:

Date	Average Height (cm)			
	Black spruce (all)	Aspen	White birch	Alder
June 1979	168	126	80	202

66-12 - BLACK SPRUCE BROADCAST SEEDING ON SFI SCARIFICATION

Assessment of Results

This relatively clean site permitted good scarification with the SFI. Production rate was 0.49 ha/h and 10 percent mineral soil exposure was achieved.

Broadcast seeding produced only marginal stocking and seedling density of black spruce eight years after seeding. The much higher percent stocking recorded in 1979 must be related to the much smaller sample taken that year.

Height growth of black spruce seedlings, as measured in 1979, has been reasonably good. Black spruce is the tallest species on the site other than alder. Alders have become the dominant feature with 71 percent stocking and 19 600 stems/ha in 1979. Alders were not recorded in the 1974 survey.

Reports and Publications

Nil.

66-13 - BLACK SPRUCE BROADCAST SEEDING ON SFI SCARIFICATION

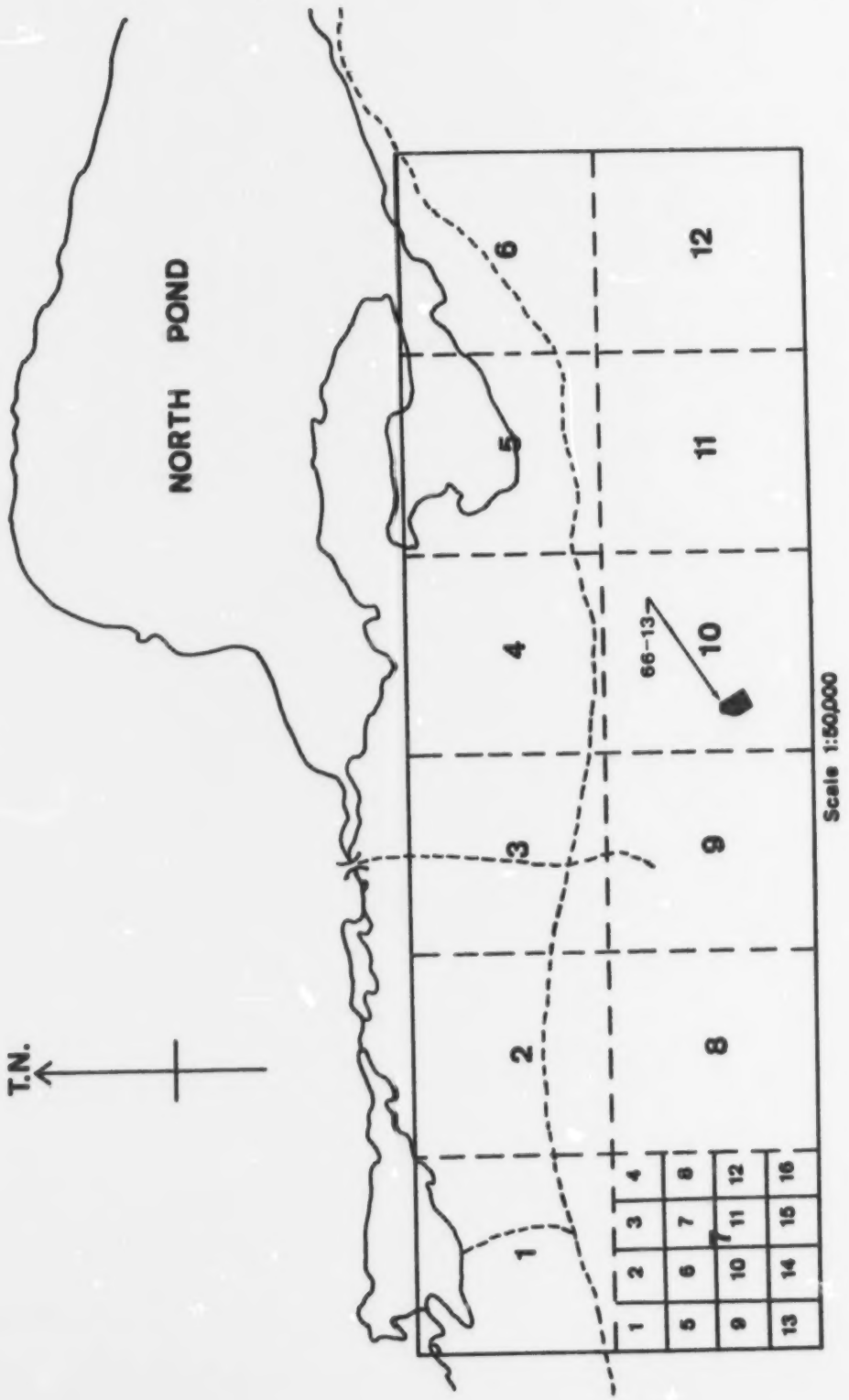
A large-scale demonstration of SFI scarification on a relatively clean burned cutover site. The area was broadcast seeded shortly after scarification; black spruce seed was applied using Cyclone seeders. This trial is similar in site and treatment to 66-12.

Site. Fresh clay loam with numerous surface boulders and a deep organic layer (15-20 cm) on a gentle to moderate north slope. The site probably originally supported productive black spruce-balsam fir stands but was burned by wildfire in 1941, may have been salvage logged in the late 1940's and was burned by wildfire again in 1961. Ground vegetation of ericaceous dwarf shrubs with moss in hollows and scattered herbs and ferns. Scattered young aspen and black spruce stems and patches of alders. Site Type 7 (p. 9).

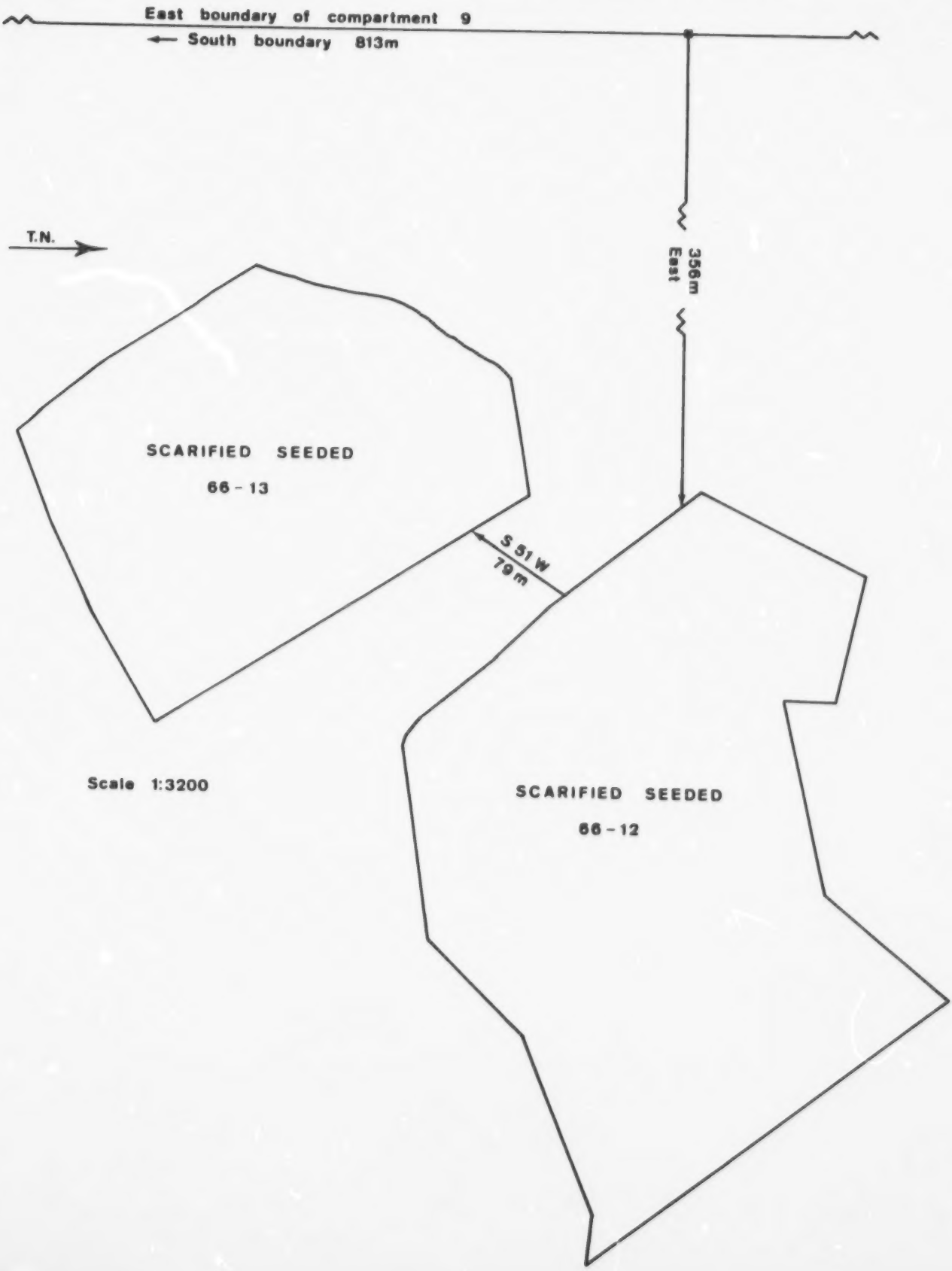
Design. Total of 5.4 ha scarified by SFI towed by wheeled skidder and producing approximately 0.23 m^2 scalps at 1.8 m spacing. Entire area broadcast seeded using hand-operated Cyclone seeders with 197 700 viable black spruce seed/ha (central Newfoundland origin).

History. Scarified July-August 1966.
Seeded November 1966.
Regeneration survey at 0.15 percent intensity June 1979.

66-13 BLACK SPRUCE BROADCAST SEEDING ON S.F.I. SCARIFICATION LOCATION



66-13 BLACK SPRUCE BROADCAST SEEDING ON S.F.I. SCARIFICATION LAYOUT



Scale 1:3200

66-13 - BLACK SPRUCE BROADCAST SEEDING ON SFI SCARIFICATION

General view of site showing ferns and alder patches, June 1969.

66-13 - BLACK SPRUCE BROADCAST SEEDING ON SFI SCARIFICATION

Results

Stocking, seedling density and height growth - June 1979:

	Black spruce	Aspen	Alder
Percent stocking	45	95	25
Seedlings/ha	2 600	1 200	45 600
Average height (cm)	68	94	109

66-13 - BLACK SPRUCE BROADCAST SEEDING ON SFI SCARIFICATION

Assessment of Results

This relatively clean site permitted rapid scarification with the SFI with a production rate of 0.67 ha/h, but only 5 percent mineral soil exposure was achieved due to the thick organic layer.

Broadcast seeding apparently produced only marginal stocking and seedling density of black spruce even if all the seedlings counted in the 1979 survey can be attributed to the seeding.

The site is much more fully stocked with aspen, though stem density is only half as great. The other dominant features are the very dense but scattered alder clumps.

Height growth of black spruce seedlings has not been as good here as in 66-12. Alder and aspen stems are both taller on average than black spruce but they also are not as tall as in 66-12, suggesting poorer nutrient status for this site.

Reports and Publications

Nil.

67-28 - ANCHOR CHAIN SCARIFICATION AND SEEDING OR PLANTING

A demonstration of anchor chain scarification on burned cut-over land. The scarification was followed by planting of Scots pine or white spruce, or broadcast seeding with black spruce.

Site. Well-drained sandy loam soil with a shallow organic layer (3-8 cm) on a moderately steep east slope which becomes almost flat at the base and gently east-sloping at the top. Original black spruce-balsam fir-white birch stands were cut in 1957-58 and the area was burned by wild-fire in 1961. Ground vegetation consists of a moss carpet with herbs on the steepest part of the slope, ericaceous dwarf-shrubs on the more gently sloping areas. There are scattered young black spruce and aspen throughout, and alders on the steep slope. Site Types 1, 3 and 6 (p. 8-9).

Design. Total of 5.7 ha in 100 m wide strip scarified by anchor chain towed by D-6 tractor producing scarified lines at approximately 0.6 m spacing. Planted and seeded in six blocks as follows:

A. Planted with Scots pine (origin Hornes, Norway - plus tree I) - 1-2 bareroot stock - 700 seedlings in block 50 m long.

B. Planted with white spruce (origin Guysborough Co., N.S.) - 3-0 bareroot stock - 700 seedlings in block 50 m long.

C. Broadcast seeded with black spruce (origin Badger, Newfoundland) - 247 000 viable seed/ha sown with cyclone seeders in block 250 m long.

D. Planted with Scots pine (origin Hornes, Norway - plus tree II) - 1-2 bareroot stock - 700 seedlings in block 50 m long.

E. Planted with Scots pine (origin Hornes, Norway - plus tree III) - 1-2 bareroot stock - 700 seedlings in block 50 m long.

F. Broadcast seeded with black spruce (origin Badger, Newfoundland) - 247 000 viable seed/ha sown with Cyclone seeders in block 170 m long.

All planting stock was raised in the North Pond Nursery and planted at about 2.4 m spacing.

History. Scarified August 1967.
Planted and seeded October 1967.
Remeasurements -

Block A - survival and height growth measured on 7 percent sample June 1977.

- survival, height growth and condition on 7 percent sample fall 1979.

Block B - survival, height growth and condition on 5 percent sample July 1978.

Block C - regeneration survey at 5 percent intensity August 1974.

- regeneration survey at 1 percent intensity July 1978.

Block D - survival, height growth and condition on 5 percent sample July 1978.

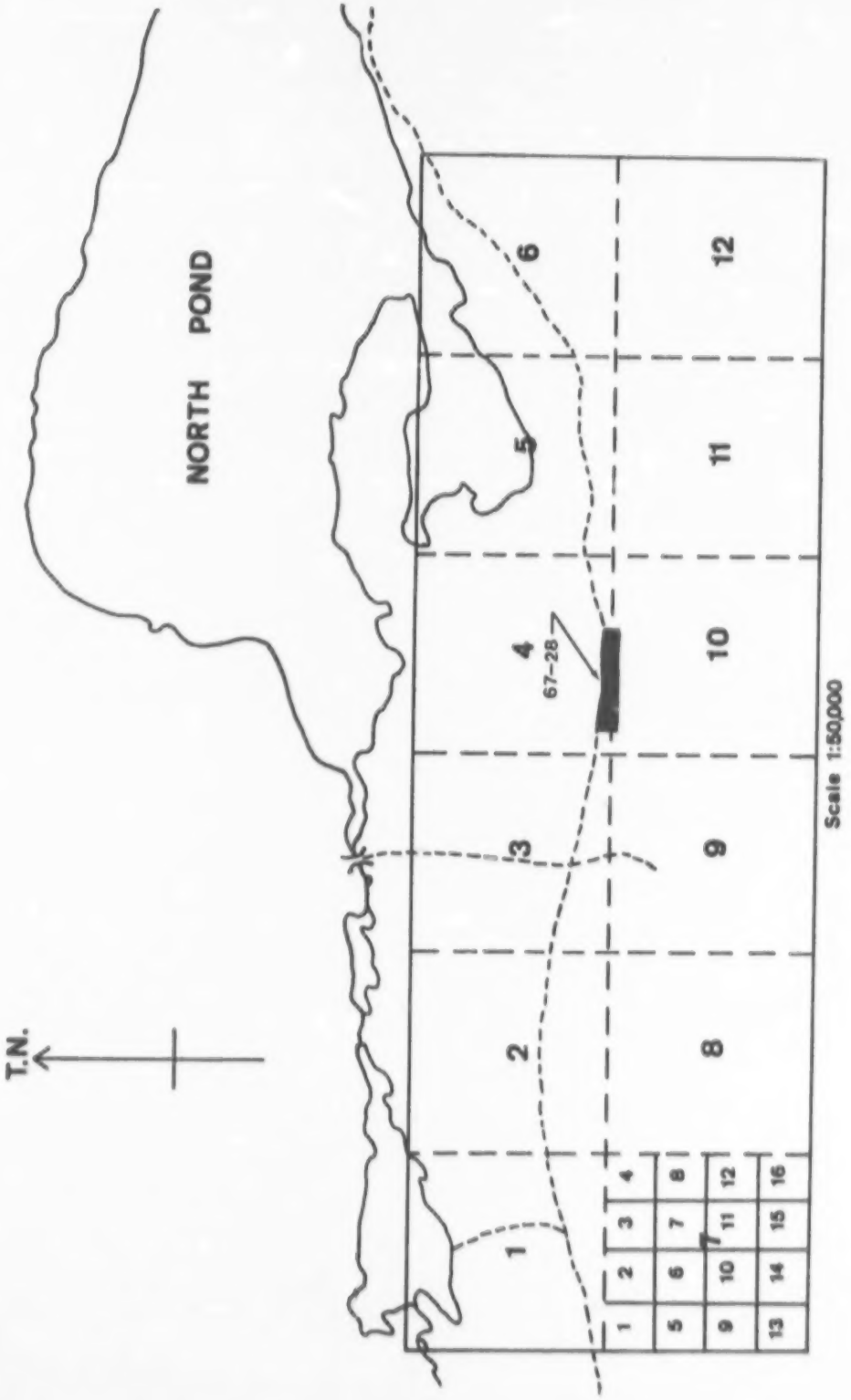
Block E - survival, height growth and condition on 5 percent sample July 1978.

Block F - regeneration survey at 6 percent intensity August 1974.

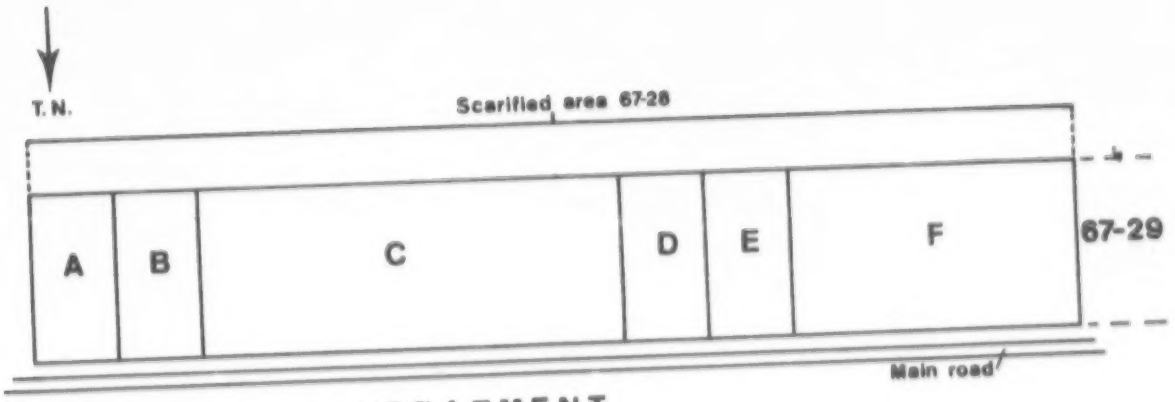
- regeneration survey at 2 percent intensity July 1978.

Cleaning - Blocks A, D, E cleaned, summer 1980.
Blocks D, E cleaned and dead trees removed, summer 1983.

67-28 ANCHOR CHAIN SCARIFICATION AND SEEDING OR PLANTING LOCATION



67-28 ANCHOR CHAIN SCARIFICATION AND SEEDING OR PLANTING LAYOUT



TREATMENT

A - Planted with 1-2 Scots Pine. Hornes, Norway*. (tree I)

B - Planted with 3-0 White Spruce. Guysborough County, Nova Scotia*

C - Broadcast seeding Black Spruce. Badger, Newfoundland*. (247,000 viable seed/ha)

D - Planted with 1-2 Scots Pine. Hornes, Norway*. (tree II)

E - Planted with 1-2 Scots Pine. Hornes, Norway* (tree III)

F - Broadcast seeding Black Spruce. Badger, Newfoundland*. (247,000 viable seed/ha)

Scale 1:4000

* Origin

67-28 - ANCHOR CHAIN SCARIFICATION AND SEEDING OR PLANTING.

White spruce planted in Block B,
February 1981, 16 years from seed,
(also natural black spruce and aspen).

Scots pine planted in Block A, February 1979,
14 years from seed.

67-28 - ANCHOR CHAIN SCARIFICATION AND SEEDING OR PLANTING

Results

Planted trees - survival and condition:

Block	Species	Date	Percentage of Trees: Healthy undamaged	Leader damaged	Foliage discolored	Other damage	Live	Dead	Missing or cut	Total
A	Scots pine	1977					91	0	9	100
		1979	66	4	1	1	73	0	27	100
B	White spruce	1978	26	26	52	62	70	0	30	100
D	Scots pine	1978	48	36	15	12	82	3	15	100
E	Scots pine	1978	61	21	0	3	82	6	12	100

Planted trees - growth:

Block	Species	Av. height when planted 1967 (cm)	Av. total height 1977/78 (cm)	Av. leader 1976/77 (cm)	Av. total height 1979 (cm)	Av. leader 1978 (cm)
A	Scots pine	38	214 (1977)	38 (1976)	326	51
B	White spruce	25-45	89 (1978)	11 (1977)		
D	Scots pine		271 (1978)	36 (1977)		
E	Scots pine		330 (1978)	43 (1977)		

Seeded blocks - stocking and seedling density:

Block	Date	Percent Stocking: Black spruce	Balsam fir	White birch	Aspen	Other species	Seedlings/ha: Black spruce	Balsam fir	White birch	Aspen	Other species
C	Aug '74	78	11	77	27	-	11,680	650	8,540	1,720	-
	Jul '78	88	16	68	51	46	10,780	1,440	5,440	2,970	3,840
F	Aug '74	87	0	13	51	-	8,660	0	530	2,810	-
	Jul '78	85	18	62	62	59	8,280	1,720	6,940	4,440	5,880

Seeded blocks - height growth:

Block	Date	Average Height (cm)						
		Black spruce	Balsam fir	White birch	Aspen	Alder	Willow	Cherry
C	July '78	174	241	149	168	165	124	93
F	July '78	159	219	165	137	145	118	95

67-28 - ANCHOR CHAIN SCARIFICATION AND SEEDING OR PLANTING

Assessment of Results

Effective scarification was accomplished with the anchor chain exposing 75 percent mineral soil. Production rate was 0.23 ha/h.

Survival of Scots pine in the plantations has been very good. Most of the missing trees are stems which have been trespass cut as Christmas trees. No dead white spruce were found but the missing ones presumably died shortly after planting. Some of the Scots pine, especially in Block D, are suffering from Armillaria root rot or root collar weevil attack. At the time of remeasurement in 1978 many of the white spruce showed signs of spruce budworm attack.

Height growth of the Scots pine has been excellent in all three blocks and they have formed more or less closed stands. The white spruce has grown much more slowly since planting. In a number of cases the planted seedlings are being suppressed by more vigorous natural black spruce and aspen.

Both seeded blocks are fully stocked to black spruce though it is now difficult to tell whether the spruce originated from the seeding or are natural. Hardwoods are also common on these sites, particularly white birch and aspen. Black spruce is somewhat denser and taller in Block C on the steep part of the slope than in Block F which is at the top of the slope.

Reports and Publications

Nil.

67-29 - SFI SCARIFICATION AND SEEDING OR PLANTING

A demonstration of SFI scarification on burned cutover land. The scarification was followed by planting of Scots pine, or broadcast seeding with Sitka spruce or black spruce.

Site. Well-drained sandy loam soil with a shallow charred organic layer (3-5 cm) on a gentle to moderate east-facing slope. Original black spruce - white birch - aspen stands were cut in 1957-58 and the area was burned by wildfire in 1961. Ground vegetation consists of moss or lichen carpet with ericaceous dwarf-shrubs and herbs. Ericaceous shrubs have increased coverage since treatment. There is abundant black spruce natural regeneration with some white birch and aspen, as well as occasional alder clumps. Site Types 3 and 6 (p. 8-9).

Design. Total of 5.3 ha in 100 m wide strip scarified by SFI scarifier towed by wheeled skidder and producing approximately 0.23 m^2 scalps at 1.8 m spacing.
Planted and seeded in four blocks:

A. Broadcast seeded on scarified scalps only, with Sitka spruce (origin Terrace, B.C.).
- 173 000 viable seed/ha sown by hand in block 200 m long.

B. Planted with Scots pine (origin Landvik, Norway - plus tree I)
- 1-2 bareroot stock - 700 seedlings in block 45 m long.

C. Planted with Scots pine (origin Landvik, Norway - plus tree II)
- 1-2 bareroot stock - 700 seedlings in block 45 m long.

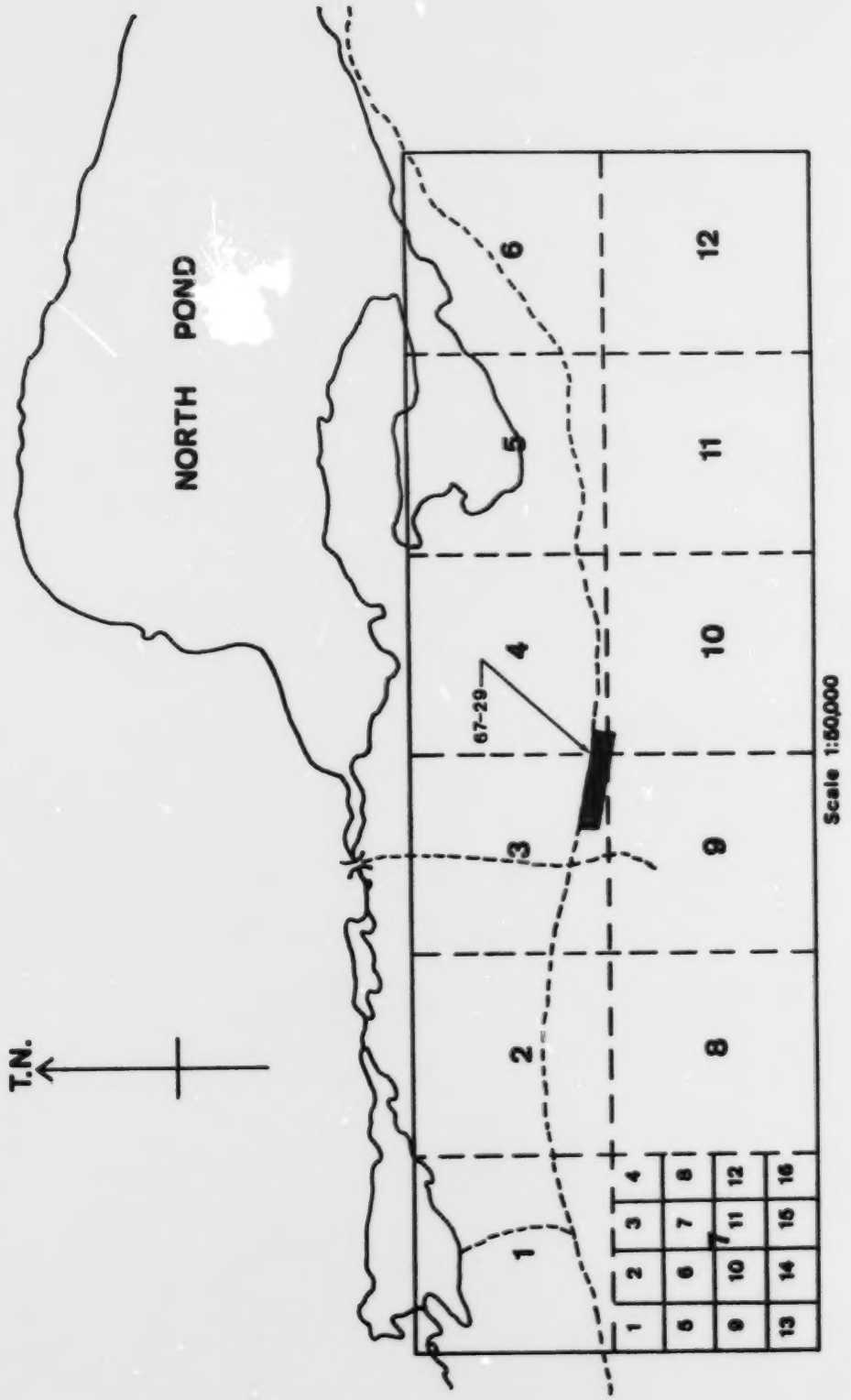
D. Broadcast seeded on scarified scalps only, with black spruce (origin Badger, Newfoundland)
- 99 000 viable seed/ha sown by hand in block 200 m long.

All planting stock was raised in the North Pond Nursery and planted at about 1.8 m spacing, where possible in SFI scalps.

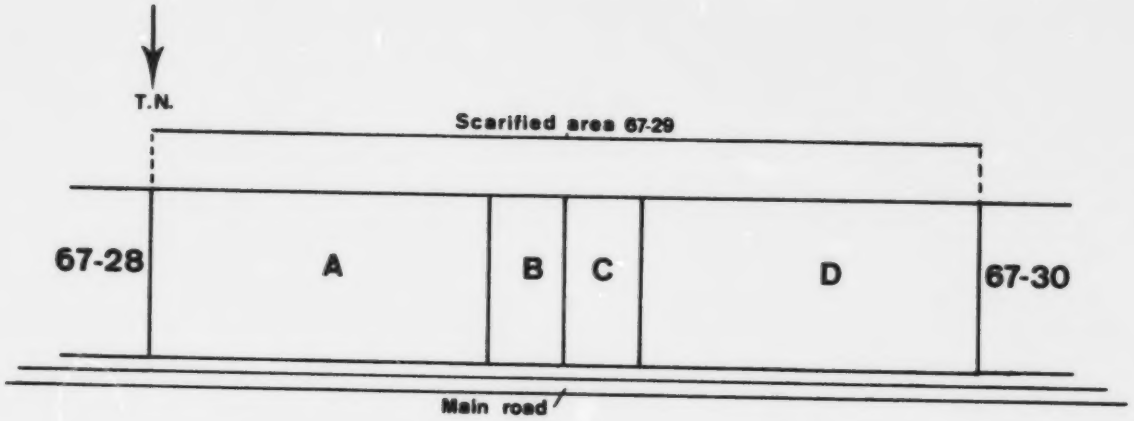
History. Scarified August 1967.
Planted and seeded October-November 1967.
Regeneration surveys at 1.6 percent intensity conducted on seeded blocks. Survival, height growth and condition measured on 4-5 percent sample of planted trees, July 1978.

67-29 S.E.I. SCARIFICATION AND SEEDING OR PLANTING

LOCATION



67-29 S.F.I. SCARIFICATION AND SEEDING OR PLANTING
LAYOUT



TREATMENT

A-Broadcast seeded on scarified scalps only, with Sitka Spruce. Terrance, British Columbia.* (173,000 viable seed/ha.)

B-Planted with 1-2 Scots Pine. Landvik, Norway.* (tree I)

C-Planted with 1-2 Scots Pine. Landvik, Norway.* (tree II)

D-Broadcast seeded on scarified scalps only, with Black Spruce. Badger, Newfoundland.* (99,000 viable seed/ha.)

Scale 1:4000

* Origin

67-29 - SFI SCARIFICATION AND SEEDING OR PLANTING

Sitka spruce broadcast seeding - small 5-year-old Sitka spruce in front of 10-12-year-old natural black spruce, May 1973.

67-29 - SFI SCARIFICATION AND SEEDING OR PLANTING

Results

Planted trees - survival and condition 1978 (Scots pine):

Block	Percentage of Trees							
	Healthy undamaged	Leader damaged	Foliage discoloured	Other damage	Live	Dead	Missing	Total
B	0	38	54	50	75	0	25	100
C	3	42	58	42	61	3	36	100

Planted trees - growth (Scots pine):

Block	Av. height when planted 1966 (cm)	Av. total height 1978 (cm)	Av. leader 1977 (cm)
B	15	60	6
C	20	76	8

Seeded blocks - stocking and seedling density:

Block	Percent Stocking 1978					Seedlings/ha 1978				
	Black spruce	Sitka spruce	White birch	Aspen	Other species	Black spruce	Sitka spruce	White birch	Aspen	Other species
B	82	15	51	49	79	7 500	750	3 750	2 060	13 030
C	94	-	30	61	51	9 780	-	2 160	3 340	7 560

Seeded blocks - height growth:

Block	Average Height (cm) 1978						
	Black spruce	Sitka spruce	White birch	Aspen	Alder	Willow	Cherry
B	190	19	196	170	162	140	81
C	161	-	239	228	178	157	111

67-29 - SFI SCARIFICATION AND SEEDING OR PLANTING

Assessment of Results

The SFI scarifier produced reasonable scarification on this site, exposing 7-10 percent mineral soil in the scalps. Production rate was 0.2 ha/h.

Scots pine survival in the plantations has not been good, with 25-36 percent of trees apparently dying soon after planting. Many of the surviving pine have discoloured needles indicating the presence of insect, disease or nutrition problems. Height growth has been very poor, averaging less than 10 cm annually since planted.

Both seeded blocks are fully stocked to black spruce, but it is difficult to tell whether they originated from the seeding or are natural. Stocking of Sitka spruce on the Sitka spruce seeded block is very low and the seedlings are very small. Hardwood stocking and density is as great as that of softwoods in both blocks. White birch, aspen, willow and cherry are the common species with occasional alder clumps. The hardwoods are about the same height as the black spruce on Block B, but are taller than the spruce on Block C in general.

Reports and Publications

Nil.

67-30 - ANCHOR CHAIN SCARIFICATION AND SEEDING

A demonstration of anchor chain scarification on burned cut-over land. The scarification was followed by broadcast seeding of part of the scarified area with black spruce.

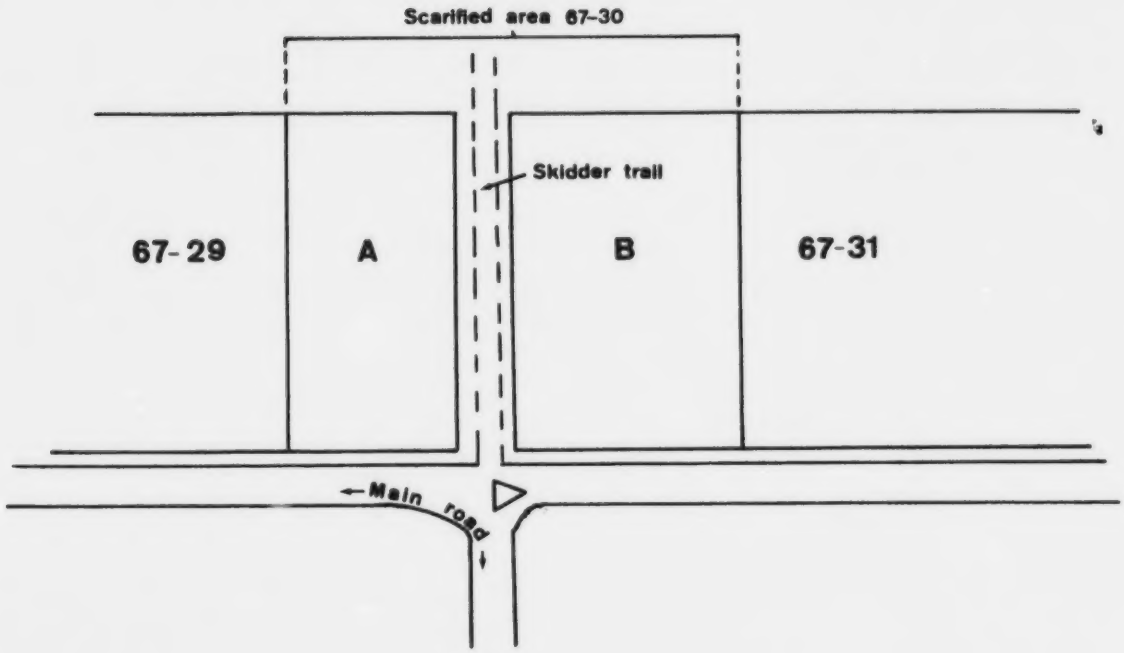
Site. Moist sandy-clay soil with a deep raw humus layer (10-20 cm) on a gentle northeast-facing slope. Original black spruce - white birch - aspen stands were cut in 1957-58 and the area was burned by wildfire in 1961. Ground vegetation consists of ericaceous dwarf-shrubs with some herbs, moss or lichen. Ericaceous cover has increased since treatment. Alders and black spruce regeneration dominate the tree layer. Site Type 6 (p. 9).

Design. Total of 1.6 ha in 100 m wide strip scarified by anchor chain towed by D-6 tractor and producing scarified lines at about 0.6 m spacing.
Block measuring 0.5 ha broadcast seeded with black spruce (origin Badger, Newfoundland) using 'selective spot seeding' technique which concentrates seed on apparently receptive scarified spots.
Seeding rate 99 000 viable seed/ha.

History. Scarified August 1967.
Seeded November 1967.
Regeneration survey at 1.6 percent intensity August 1978.

67 30 ANCHOR CHAIN SCARIFICATION AND SEEDING

LAYOUT



TREATMENT

A-Black Spruce broadcast seeded using selective spot seeding. Badger, Newfoundland.* (99,000 viable seed/ha.)

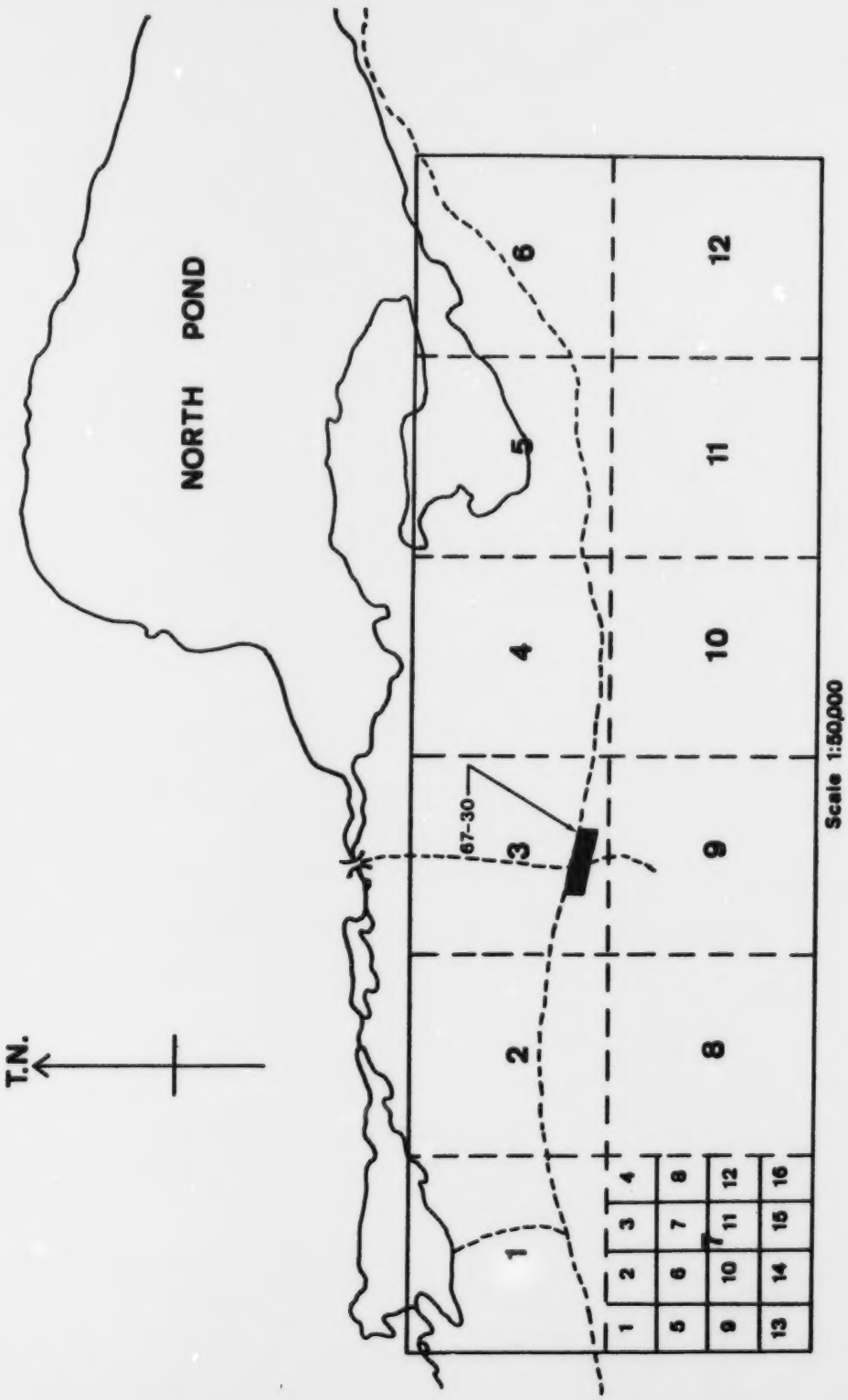
B-Unseeded

Scale 1:2000

* Origin

67-30 ANCHOR CHAIN SCARIFICATION AND SEEDING

LOCATION



67-30 - ANCHOR CHAIN SCARIFICATION AND SEEDING

Results

Stocking and seedling density:

Date	Percentage Stocking					Seedlings/ha				
	Black spruce	Alder	Aspen	Cherry	Other sp.	Black spruce	Alder	Aspen	Cherry	Other sp.
Aug 1978	85	85	45	40	45	12000	28250	2880	2250	2750

Height growth:

Date	Average Height (cm)					
	Black spruce	Alder	Aspen	Cherry	Willow	White birch
August 1978	165	221	255	107	87	265

67-30 - ANCHOR CHAIN SCARIFICATION AND SEEDING

Assessment of Results

Reasonable scarification was accomplished by the anchor chain scarifier with a production rate of 0.23 ha/h.

The seeded block is densely stocked with black spruce which may have originated naturally rather than from the seeding. Alders are even denser on the seeded block and are the dominant woody vegetation both in number of stems and in height. Aspen, cherry and willow are also common on this site but white birch occurs only as a few tall individuals.

Reports and Publications

Nil

67-31 - SCARIFICATION AND SEEDING OR PLANTING

A demonstration on burned cutover land of the combination of SFI scarification and anchor chain scarification. Part of the scarified area was subsequently broadcast seeded with black spruce or planted with Scots pine.

Site. Well-drained to very moist sandy-clay soil with charred humus layer varying from 3 to 30 cm in depth on a generally gentle north-facing slope, becoming almost flat in places. Original black spruce - balsam fir - white birch stands were cut in late 1950's and the area was burned by wildfire in 1961. Ground vegetation consists of moss or grass carpet with herbs and, in places, ericaceous dwarf-shrub cover. Black spruce natural regeneration is common with birch, aspen, willow and pin cherry, and occasional alder clumps. Site Type 3 and 6 (p. 8-9).

Design. Total of 13.8 ha in 100 m wide strip scarified first by SFI towed by wheeled skidder producing approximately 0.23 m^2 scalps at 1.8 m spacing, then scarified by anchor chain towed by D-6 tractor producing scarified lines at about 0.6 m spacing.
Part of strip left unreforested.
Remainder treated in four blocks:

A. Broadcast seeded on scarified scalps only, with black spruce (origin Badger, Newfoundland).
- 99 000 viable seed/ha sown by hand in block 125 m long.

B. Planted with Scots pine (origin Kilen, Norway - plus tree 1II)
- 2-1 bareroot stock - 700 seedlings in block 45 m long.

C. Broadcast seeded on scarified scalps only, with black spruce (origin Badger, Newfoundland).
- 99 000 viable seed/ha sown by hand in block 80 m long.

D. Broadcast seeded over entire site with black spruce (origin Badger, Newfoundland).
- 99 000 viable seed/ha sown by hand in block 200 m long.

History. Scarified August - September 1967.
Seeded and planted November 1967.
Remeasurements -

Block A - regeneration survey at 1 percent intensity, August 1978.

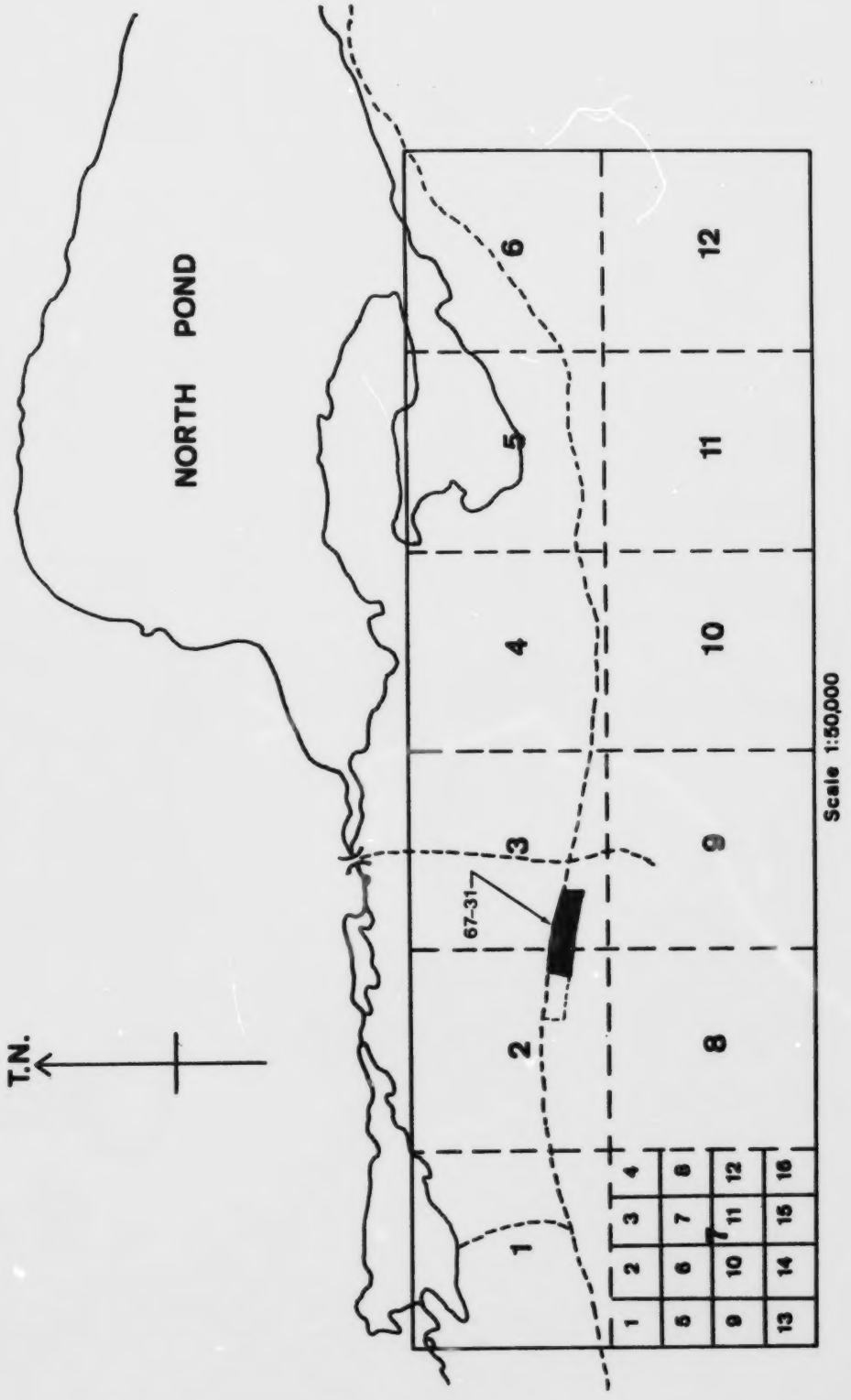
Block B - survival, height growth and condition on 5 percent sample, July 1978.

Block C -regeneration survey at 2 percent intensity, August 1978.

Block D - regeneration survey at 1 percent intensity, August 1978.

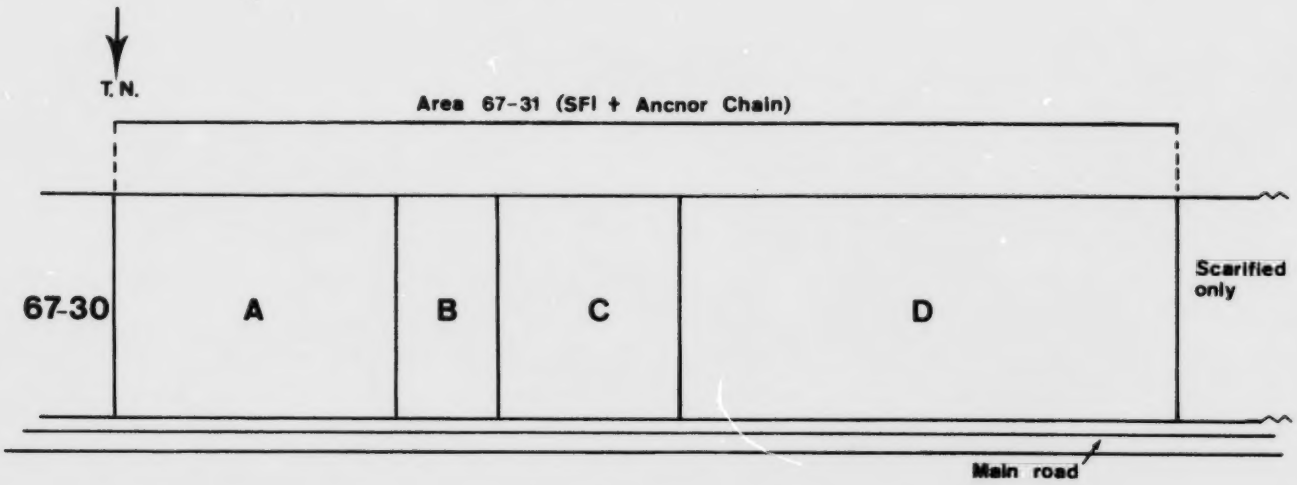
67-31 SCARIFICATION AND SEEDING OR PLANTING

LOCATION



67-31 SCARIFICATION AND SEEDING OR PLANTING

LAYOUT



TREATMENTS

A - Black Spruce broadcast seeded on scarified scalps only. Badger, Newfoundland.* (99,000 viable seed/ha.)

B - Planted with 2-1 Scots Pine. Kilen, Norway.* (Plus tree III)

C - Black Spruce broadcast seeded on scarified scalps only. Badger, Newfoundland. (99,000 viable seed/ha.)

D - Black Spruce broadcast seeded over entire site. Badger, Newfoundland.* (99,000 viable seed/ha.)

Scale 1:3000

* Origin

67-31 - SCARIFICATION AND SEEDING OR PLANTING

Results

Seeded blocks - stocking and seedling density, 1978:

Block	Percent Stocking					Seedlings/ha				
	Black spruce	White birch	Aspen	Willow	Other species	Black spruce	White birch	Aspen	Willow	Other species
A	58	40	58	55	58	4880	4310	3750	5690	3250
C	80	22	32	20	22	16620	1480	1610	930	1300
D	82	44	41	46	36	9230	4420	2250	3740	4970

Seeded blocks - height growth, 1978:

Block	Average Height 1978 (cm)							
	Black spruce	Balsam fir	White birch	Aspen	Willow	Cherry	Alder	Larch
A	123	-	212	239	204	126	44	-
C	143	145	251	177	117	149	122	-
D	204	27	187	170	158	97	165	153

Planted Scots pine - survival and condition, 1978:

Percentage of Trees							
Healthy undamaged	Leader damaged	Foliage discoloured	Other damage	Live	Dead	Missing	Total
44	38	6	44	94	0	6	100

Planted Scots pine - growth:

Av. height when planted 1967 (cm)	Av. total height 1978 (cm)	Av. leader 1977 (cm)
18	182	25

67-31 - SCARIFICATION AND SEEDING OR PLANTING

Assessment of Results

The combination of two methods of scarification produced considerable exposure of mineral soil - 7-10 percent after the SFI, 80-85 percent total after the anchor chain. Production rates were 0.20 ha/h for the SFI, 0.23 ha/h for the anchor chain.

Blocks C and D are fully and densely stocked with black spruce which may have originated naturally or as a result of the seeding. In light of the high degree of soil disturbance, it seems likely that an appreciable part of the spruce came from the seeding since the disturbance would likely have destroyed much of any pre-existing natural regeneration. Black spruce stocking is moderate on Block A where the spruce are much smaller than the dominant hardwoods. On the other seeded blocks, spruce is dominant, in numbers on Block C, and in height and numbers on Block D.

Survival of the planted Scots pine has been good, and although only 44 percent of the trees were classed as fully healthy and undamaged, many of the others had only light damage, mainly aphid attack on the stems. Growth of the pine has been reasonably good.

Reports and Publications

Nil.

B. PLANTING

NF-79 - SITKA SPRUCE BULLET PLANTING

An early experiment designed to compare a range of planting dates throughout the growing season for Sitka spruce seedlings raised in Walters' bullet containers.

Site. Fresh to moist gentle south slope with moderately deep organic soil layer. Original softwood stands were cut in 1957-58, and the area was burned by wildfire in 1961. Ground vegetation was virtually absent at time of establishment. It now has a moss carpet with aspen regeneration, and on the lower part of the slope ericaceous dwarf-shrubs. Site Types 1 and 6 (p. 8-9).

Design. Four rows of 50 Sitka spruce seedlings were to have been planted at two-weekly intervals over a 10-week period from early June to late September, having been started from seed four months earlier, in two consecutive years. Seed of Terrace, B.C. origin (84 percent viability) was sown in the bullets at intervals as required and the seedlings were raised in a heated greenhouse, but germination was low and insufficient seedlings were produced for the designed plantings. Seven plantings were made the first year and 10 incomplete plantings the second year.

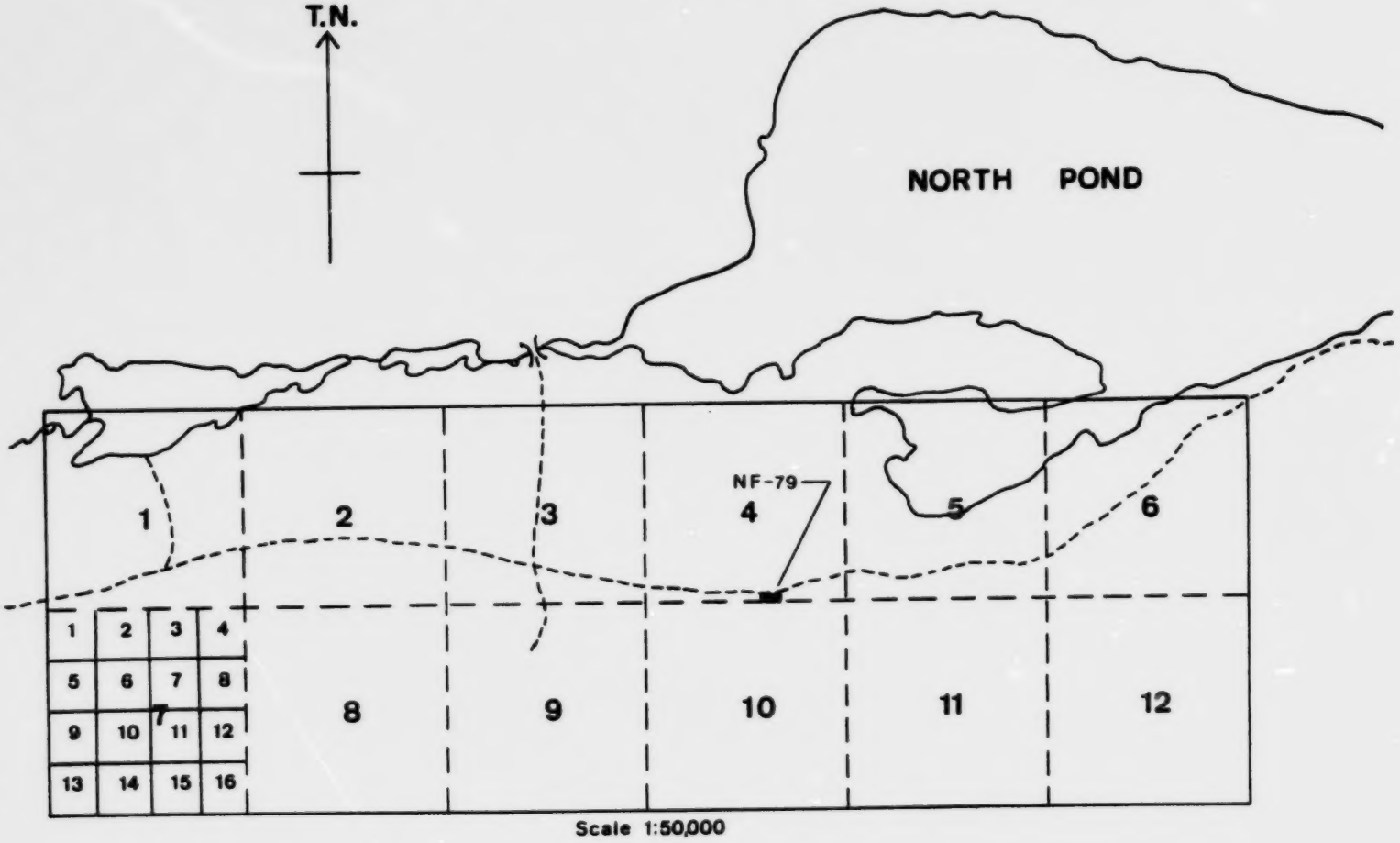
Seedlings were planted at 2 m spacing using a dibble and marked by red-painted wooden or wire pickets.

Total area of experiment - 1.3 ha.

History. Plantation established 1964-65.
Twice-yearly survival counts made 1965-68.

NF-79 SITKA SPRUCE BULLET PLANTING

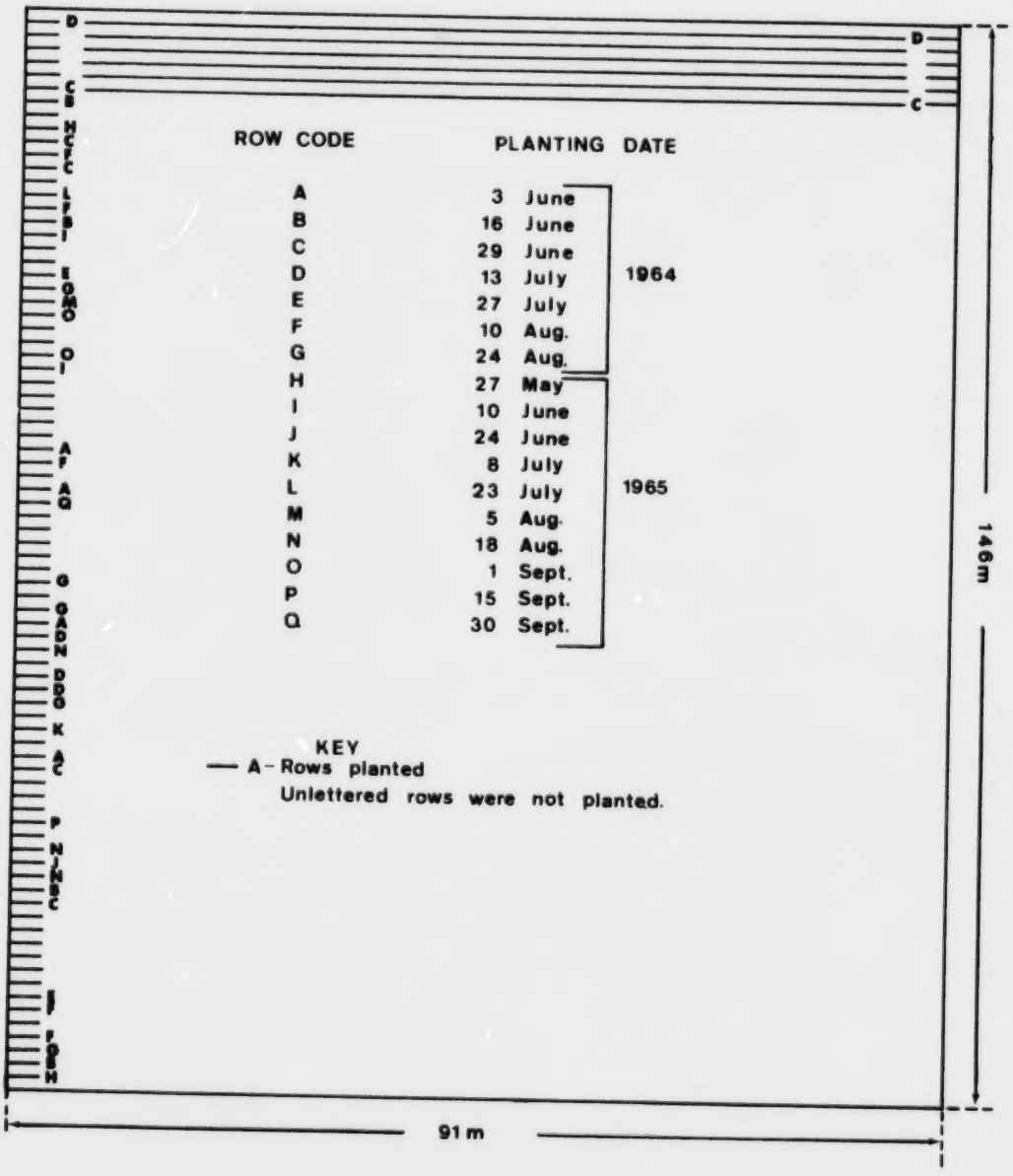
LOCATION



Scale 1:50,000

NF-79 SITKA SPRUCE BULLET PLANTING

LAYOUT



ROW CODE	PLANTING DATE	
A	3 June	1964
B	16 June	
C	29 June	
D	13 July	
E	27 July	
F	10 Aug.	
G	24 Aug.	
H	27 May	1965
I	10 June	
J	24 June	
K	8 July	
L	23 July	
M	5 Aug.	
N	18 Aug.	
O	1 Sept.	
P	15 Sept.	
Q	30 Sept.	

KEY

— A – Rows planted

Unlettered rows were not planted.

T.N.

NF-79 - SITKA SPRUCE BULLET PLANTING

Good speciman of Sitka spruce (2.4 m) amongst much taller aspen, February 1981.

Range of growth of Sitka spruce in plastic bullets, August 1968.

NF-79 - SITKA SPRUCE BULLET PLANTING

Results

Sitka spruce survival (percent):

Planting date	Number of seedlings planted	Percent Survival	
		Spring 1966	Fall 1968
1964 - June 3	201	5	3
June 16	203	20	18
June 29	208	49	43
July 13	204	47	37
July 27	114	42	35
August 10	256	49	37
August 24	250	47	43
1965 - May 27	124	14	15
June 10	91	22	14
June 24	43	35	28
July 8	15	13	13
July 23	16	81	44
August 5	5	60	20
August 18	154	87	73
September 1	66	98	94
September 15	38	79	61
September 30	37	89	76
Average		43	36

Frost-heaving:

Year	Bullets heaved (%)
1964-65	32
1965-66	31
1966-67	41

NF-79 - SITKA SPRUCE BULLET PLANTING

Assessment of Results

Planting Sitka spruce in plastic bullet containers on this site was not a success. Frost-heaving of the smooth-sided containers was a major cause of mortality. Other causes included smothering by debris, excessive heat in some microsites and frost damage in other microsites.

Survival was somewhat better for seedlings planted late in the growing season than for those planted earlier.

The rigid plastic containers, though weakened by a narrow slit so that they split fairly easily, do not break down in the soil. Seedlings excavated in the late 1970's still had the containers more or less intact and showed root deformities.

Reports and Publications

Wilton, W.C. 1965. Progress to date on capsule planting. Project NF-79. Can. Dep. Forest., Forest. Res. Br., St. John's, Nfld. File Report.

Hall, J. Peter. 1969. 1968 results of four planting research projects. Can. Dep. Fish. & Forest., Can. Forest. Serv., Internal Report N-18. 15 p.

Hall, J. Peter. 1970. Results of two container planting studies in central Newfoundland. Can. Dep. Fish. & Forest., Can. Forest. Serv., St. John's, Nfld. File Report. 15 p.

3-S-66 - ONTARIO TUBELING PLANTING

A small trial of Ontario tubes for raising and planting seedlings, using Sitka spruce. It was designed to compare six different soil mixes used to fill the containers, and two different periods of growth before out-planting.

Site. Very gentle south slope (near top of slope), with well-drained soil. Original balsam fir-white birch stands cut for pulpwood in 1957-58 and area burned in 1961 wildfire. Organic soil covering is relatively thin. Ground vegetation of moss carpet with some herbs and scattered low shrubs. Abundant natural regeneration of aspen, birch and willow. Site Type 1 (p. 8).

Design. Six soil mixes were used to fill 'Ontario tubes': a) Sterilized commercial potting compound, b) Loam (L) + peat moss (P) + sand (S), 1:1:1, c) L + P + vermiculite (V), 1:1:1, d) P + V, 1:1, e) L + S, 1:1, f) L + P, 1:1.

Sitka spruce seed of Terrace, B.C. origin was sown in the tubes and seedlings grown in laboratory for two months or three months before outplanting.

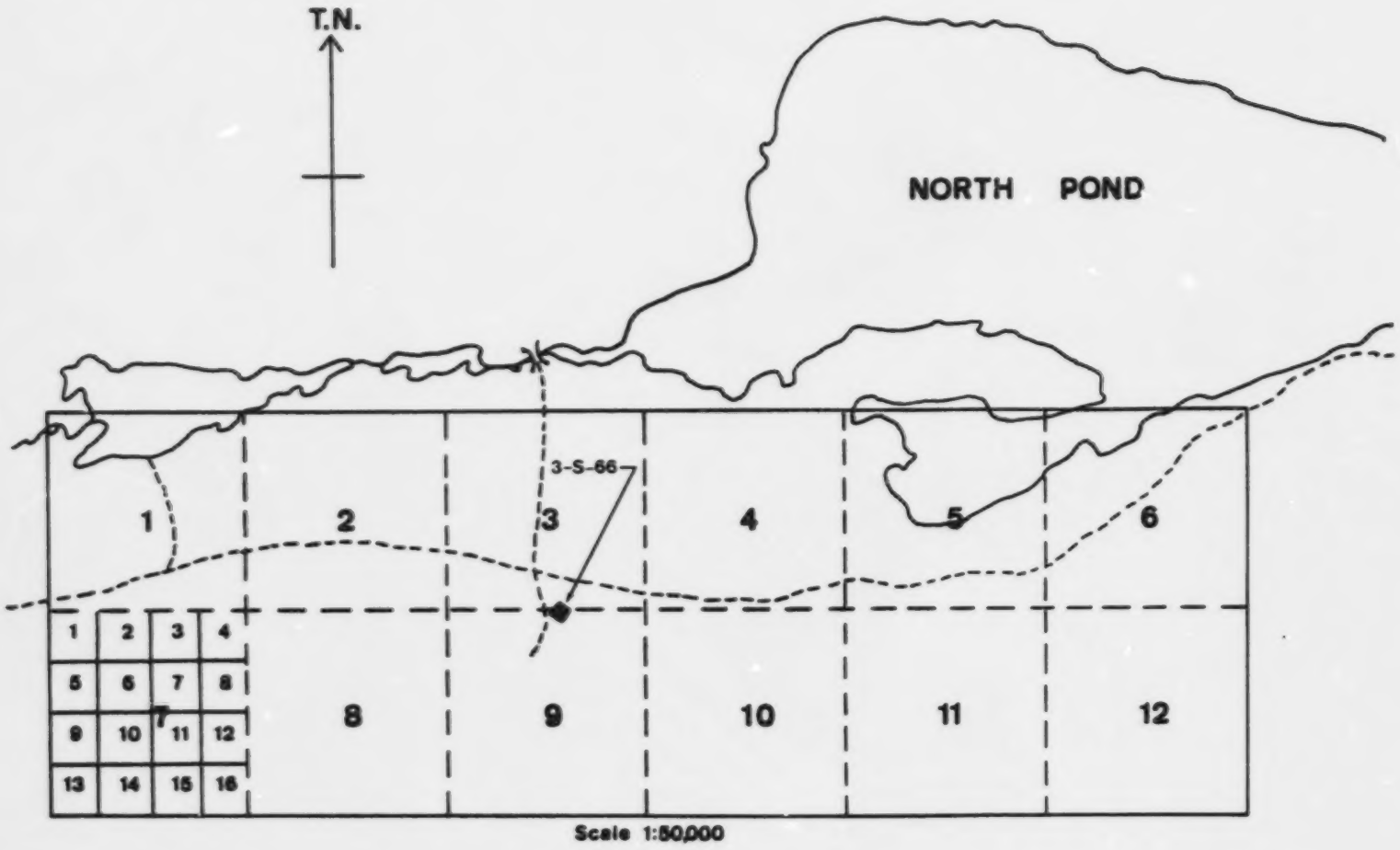
Plantation was designed to have two rows of 50 seedlings for each treatment combination (soil mix + sowing date), but insufficient seedlings were produced.

Seedlings were planted at 2 m spacing using a dibble and were marked by red-painted wire pickets.

Total area of experiment - 0.4 ha.

History. Plantation established June 1966.
Twice-yearly survival counts made 1966-68.
Survival and height growth measured October 1975.
Survival, height and leader length measured June 1979.
Competing hardwoods removed, summer 1980.

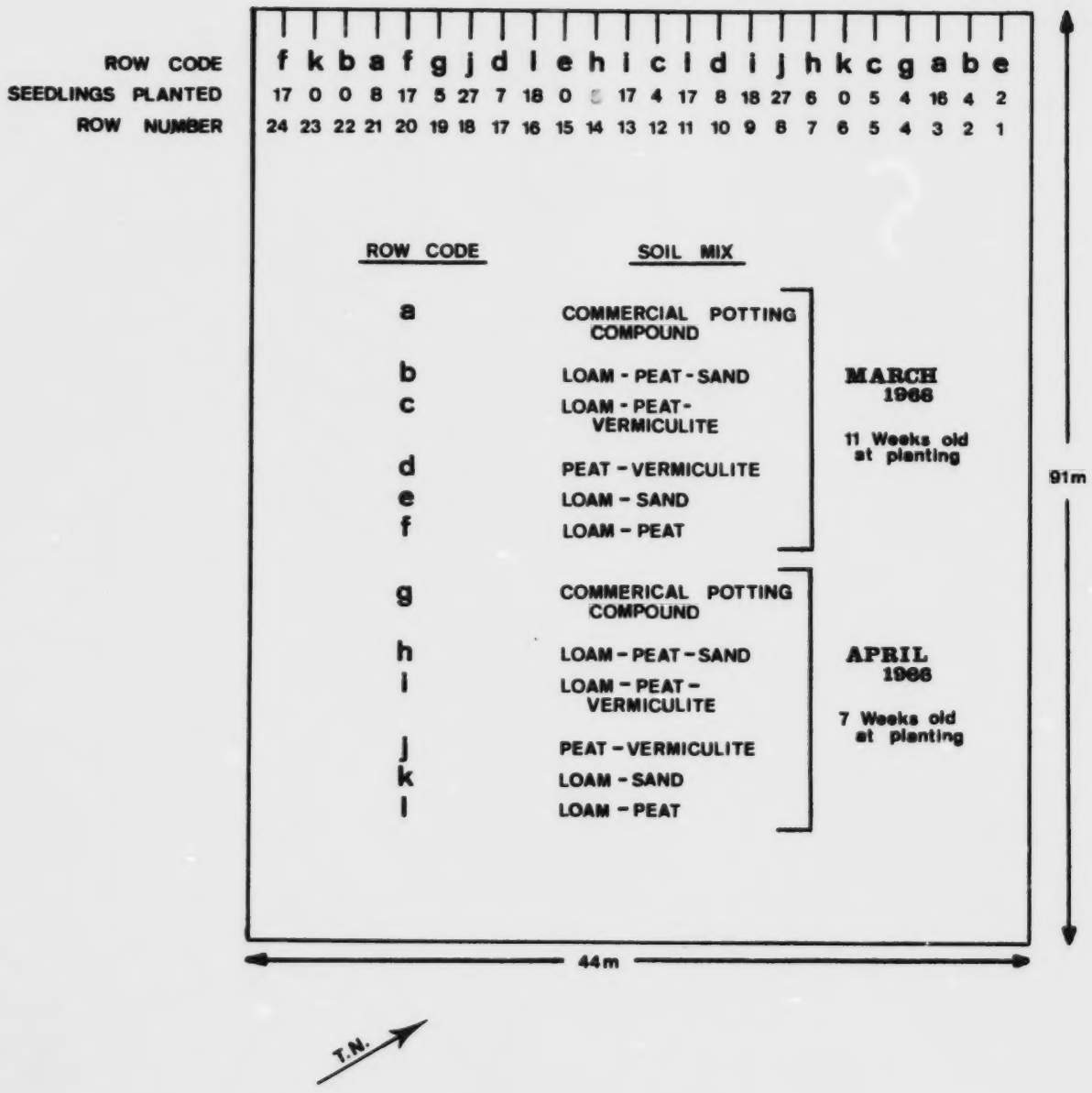
3-S-66 ONTARIO TUBELING PLANTING LOCATION



Scale 1:50,000

3-S-66 ONTARIO TUBELING PLANTING

LAYOUT


ROW CODE
SEEDLINGS PLANTED
ROW NUMBER
f k b a f g j d l e h i c l d i j h k c g a b e
17 0 0 8 17 5 27 7 18 0 0 17 4 17 8 18 27 6 0 5 4 16 4 2
24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
ROW CODE
SOIL MIX
a COMMERCIAL POTTING COMPOUND
b LOAM - PEAT - SAND
c LOAM - PEAT - VERMICULITE
d PEAT - VERMICULITE
e LOAM - SAND
f LOAM - PEAT
MARCH 1966
11 Weeks old at planting
g COMMERICAL POTTING COMPOUND
h LOAM - PEAT - SAND
i LOAM - PEAT - VERMICULITE
j PEAT - VERMICULITE
k LOAM - SAND
l LOAM - PEAT
APRIL 1966
7 Weeks old at planting
91m
44m
T.N.

Range of growth of Sitka spruce in Ontario tubes (3 years from seed), August 1968.

Good growing Sitka spruce (c. 3 m) 15 years from seed, in Ontario tube, July 1981.

3-S-66 - ONTARIO TUBELING PLANTING

Results

Sitka spruce survival (percent):

Soil mix	March 1966 Sowing				April 1966 Sowing			
		Percent Survival				Percent Survival		
	No. planted	Fall 1966	Spring 1967	Spring 1979	No. planted	Fall 1966	Spring 1967	Spring 1979
Commercial potting comp.	24	67	67	33	9	11	11	11
Loam + peat + sand	4	50	50	25	11	45	27	18
Loam + peat + vermiculite	9	56	56	44	35	57	54	40
Peat + vermiculite	15	27	20	20	54	54	50	41
Loam + sand	2	0	0	0	0	-	-	-
Loam + peat	34	65	59	41	65	20	20	20
All soil mixes	88	56	52	34	144	43	40	32

Sitka spruce growth (cm):

Soil mix	March 1966 Sowing				April 1966 Sowing			
		Total height (cm)		Leader (cm)		Total height (cm)		Leader (cm)
	No. planted	Fall 1975	Spring 1979	Spring 1979	No. planted	Fall 1975	Spring 1979	Spring 1979
Commercial potting comp.	24	54	83	11	9	30	60	16
Loam + peat + sand	4	46	63	11	11	20	46	9
Loam + peat + vermiculite	9	73	129	21	35	42	86	14
Peat + vermiculite	15	56	95	18	54	49	91	16
Loam + sand	2	-	-	-	0	-	-	-
Loam + peat	34	89	128	16	65	55	64	9
All soil mixes	88	75	111	16	144	51	83	14

3-S-66 - ONTARIO TUBELING PLANTING

Assessment of Results

Planting 7- or 11-week-old Sitka spruce seedlings in Ontario tubes was not successful on this site. Most mortality occurred during the first growing season after planting. Subsequently, frost-heaving increased the mortality. The planted seedlings were very small and mortality was also caused by vegetative competition and smothering by litter fall.

Loam + sand and loam + peat + sand were evidently not good media for germination. There were no major differences between soil mixes in either survival or height growth, but loam + peat + vermiculite, peat + vermiculite, and loam + peat seem to be associated with somewhat better survival and growth.

Seedlings 11 weeks old when planted (March sowing) have shown better survival and growth than seedlings seven weeks old when planted (April sowing).

Reports and Publications

Hall, J. Peter. 1969. 1968 results of four planting research projects. Can. Dep. Fish. & Forest., Can. Forest. Serv., Internal Report N-18. 15 p.

Hall, J. Peter. 1970. Results of two container planting studies in central Newfoundland. Can. Dep. Fish. & Forest., Can. Forest. Serv., St. John's, Nfld. File Report. 15 p.

5-S-66 - BLACK SPRUCE PLANTING ON SFI SCARIFICATION

A small-scale trial of planting black spruce on wet heathland prepared by SFI scarification. The experiment was designed to compare two planting seasons and three planting microsites on the scalps produced by the SFI.

Site. Flat, very moist to wet with a deep matted organic layer over strongly gleyed mineral soil. It is doubtful whether the area ever supported merchantable forest, even before wildfire in 1941. Ground cover is dominated by ericaceous dwarf shrubs with some Sphagnum moss and lichen. Scattered alders and occasional black spruce and tamarack stems. Site Type 5 (p. 9).

Design. Latin square with factorial arrangement of treatments and six replications.

Treatments are two planting dates (fall and spring) and three microsites (bottom, middle and top of SFI scalp) in all combinations.

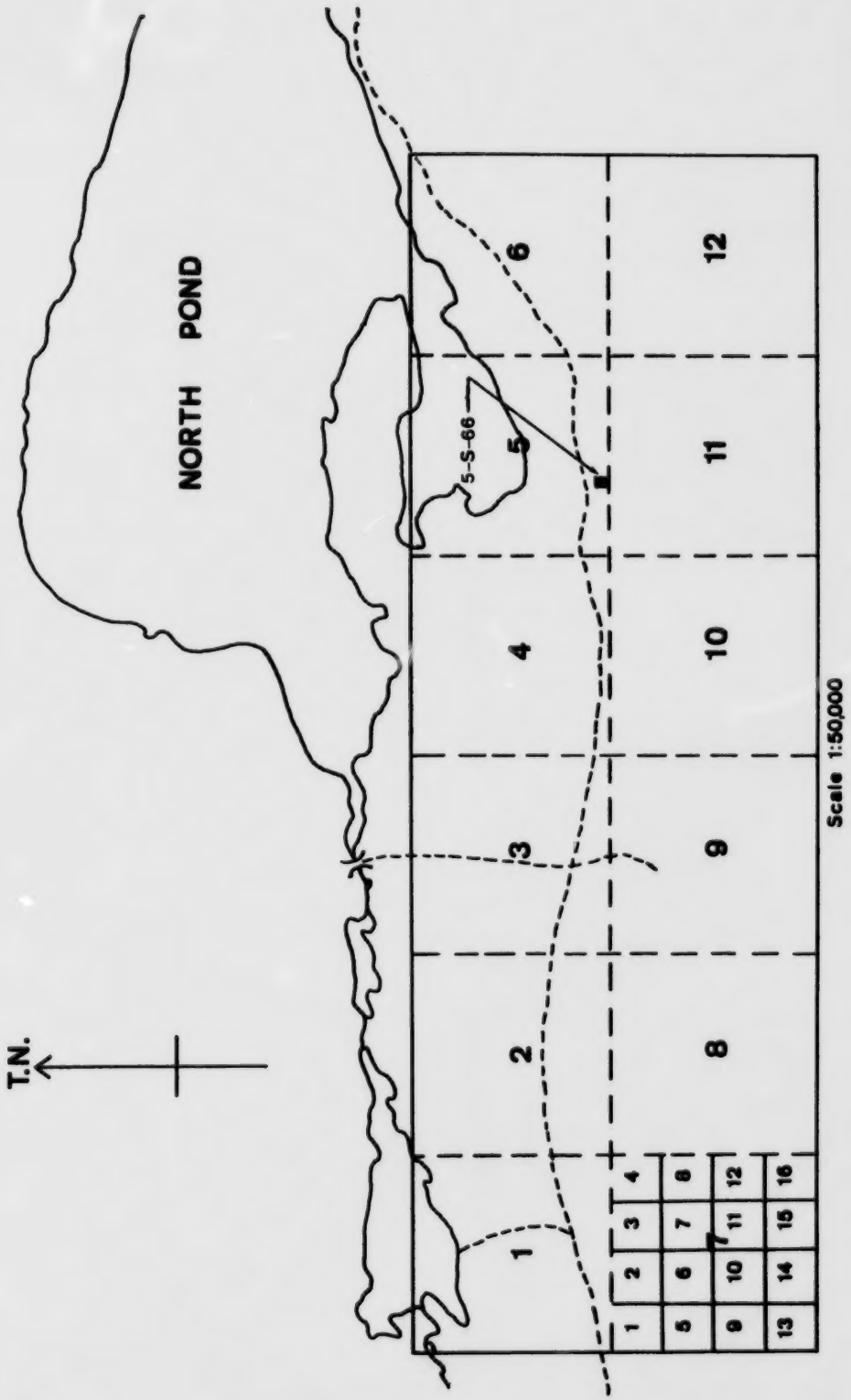
Ten black spruce (2-0 stock of Northumberland County, N.B. origin, average 14 cm tall and spindly when planted) planted in each treatment plot at approximately 1.8 m spacing.

Thirty-six plots, each 33 m^2 - total area of experiment 0.12 ha.

History. Scarified August 1966.
Planted October 1966 and May 1967.
Survival count of all seedlings fall 1968.
Survival and growth of all seedlings measured fall 1971.
Survival and growth of 17 percent of seedlings remeasured June 1979.

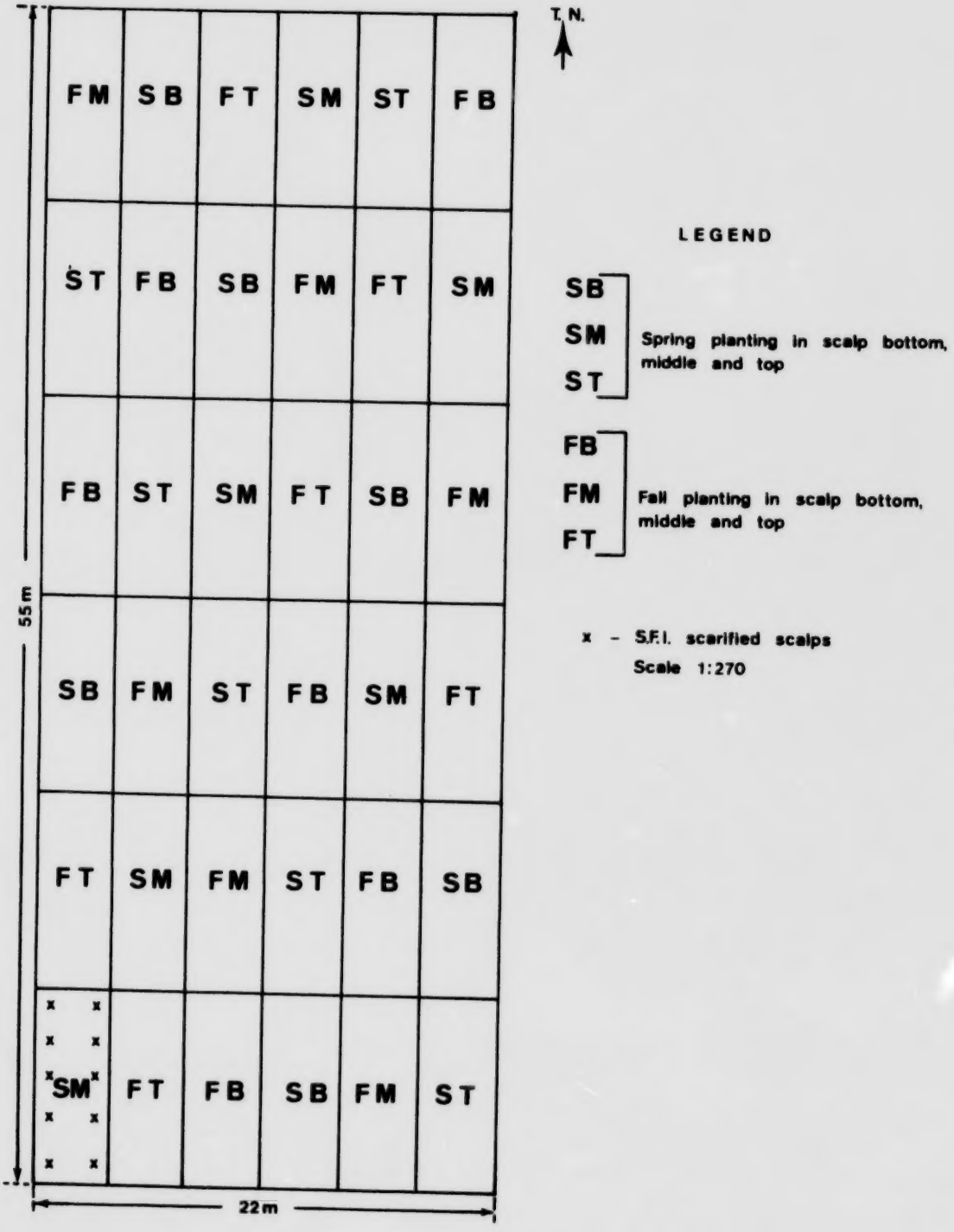
5-S-66 BLACK SPRUCE PLANTING ON S.F.I. SCARIFICATION

LOCATION



5-S-66 BLACK SPRUCE PLANTING ON S.F.I. SCARIFICATION

LAYOUT



LEGEND

SB, SM, ST — Spring planting in scalp bottom, middle and top

FB, FM, FT — Fall planting in scalp bottom, middle and top

x – S.F.I. scarified scalps

Scale 1:270

5-S-66 - BLACK SPRUCE PLANTING ON SFI SCARIFICATION

Slow-growing black spruce planted in middle position on SFI scalp, photo July 1978, 12 growing seasons after planting.

5-S-66 - BLACK SPRUCE PLANTING ON SFI SCARIFICATION

Results

Black spruce survival:

Planting season	Microsite	Black Spruce Percent Survival		
		Fall 1968	Fall 1971	Spring 1979*
Fall	Scalp bottom	50	28	0
	Scalp middle	65	53	80
	Scalp top	53	53	70
	All sites	56	45	50
Spring	Scalp bottom	37	37	10
	Scalp middle	57	57	70
	Scalp top	60	42	30
	All sites	51	46	37
Both seasons	Scalp bottom	43	33	5
	Scalp middle	61	56	75
	Scalp top	57	48	50

Black spruce growth:

Planting season	Microsite	Black Spruce Total Height (cm)		Black Spruce Leader Length (cm)	
		Fall 1971	Spring 1979*	Fall 1971	Spring 1979*
Fall	Scalp bottom	18.2	-	1.9	-
	Scalp middle	23.5	34.4	1.8	1.5
	Scalp top	21.2	22.2	2.0	0.7
	All sites	21.5	28.7	1.9	1.1
Spring	Scalp bottom	18.6	19.3	1.7	0.6
	Scalp middle	22.0	21.5	1.8	1.6
	Scalp top	21.1	30.3	1.8	1.1
	All sites	20.8	23.7	1.8	1.4
Both seasons	Scalp bottom	18.5	19.3	1.8	0.6
	Scalp middle	22.8	28.4	1.8	1.6
	Scalp top	21.1	24.6	1.9	0.8

*Partial remeasurement.

5-S-66 - BLACK SPRUCE PLANTING ON SFI SCARIFICATION

Assessment of Results

Planting black spruce 2-0 seedlings on SFI scarified scalps on this wet heathland site has not been successful. Considerable seedling mortality occurred due to flooding on lower habitats and exposure on upper habitats. Most mortality occurred within the first two growing seasons after planting.

Height growth on surviving seedlings has been poor due to the lack of available nutrients in the soil, and from lack of aeration in the lower habitats.

No clear difference in survival or growth was apparent between fall and spring planting dates.

Survival and growth were slightly better on middle and top planting sites than on the scalp bottom.

Reports and Publications

Hall, J. Peter. 1969. 1968 results of four planting research projects. Can. Dep. fish. & Forest., Can. Forest. Serv., Internal Report N-18, 15 p.

Hall, J. Peter. 1972. Planting black spruce on wet heathland following scarification. Environ. Can., Can. Forest. Serv., Information Report N-X-74. 11 p.

2-S-68 - SITKA SPRUCE COMPARISON OF PLANTING STOCK

A small-scale direct comparison of Sitka spruce planting stock from mineral soil nursery transplant beds and from peat transplant beds, both types outplanted together on mineral soil. (This trial is paralleled by a similar one at Colinet on the Avalon Peninsula in which the same stock types were outplanted on cultivated peat.)

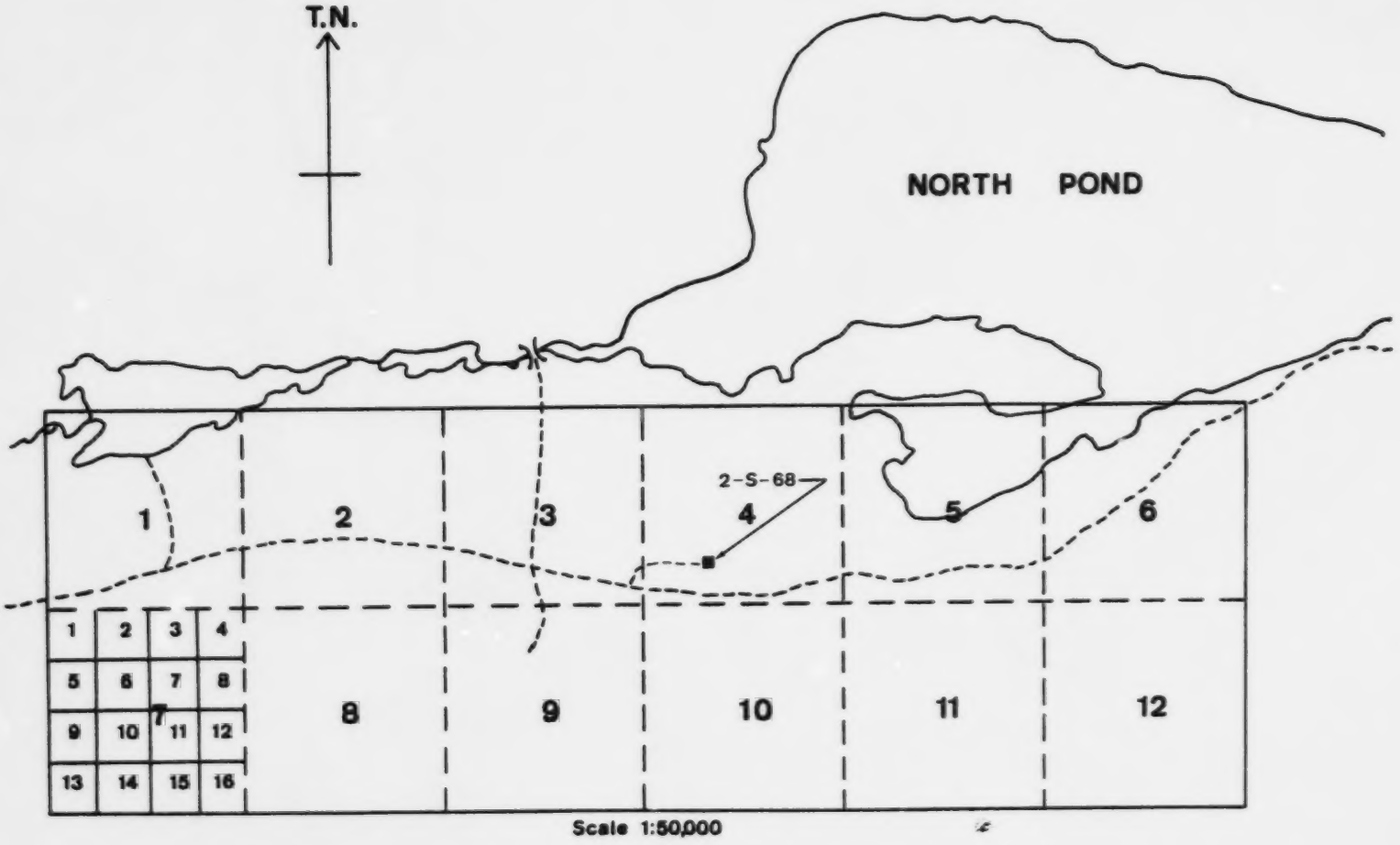
Site. Fresh, well-drained sandy loam on a gentle east slope. Original balsam fir-black spruce stand cutover for pulpwood in late 1950's, before burning by wildfire in 1961. Ground vegetation of moss carpet with herbs and natural regeneration of aspen, white birch, pin cherry and black spruce. Site Type 3 (p. 8).

Design. Paired comparison of a) 1-1 Sitka spruce from peat transplant beds (one year in mineral soil seedbeds at North Pond, one year transplanted under plastic on cultivated peat at Colinet) and b) 1-1 Sitka spruce from mineral soil transplant beds (one year in mineral soil seedbeds, one year transplanted in mineral soil, both years at North Pond). Seed origin Terrace, B.C.

Fifty pairs of seedlings were planted with 0.9 m between members of a pair, 1.5 m between pairs.

History. Planted spring 1968.
Survival and growth measured fall 1968.
Survival and growth remeasured fall 1969, 1970.
Survival and growth remeasured fall 1972.
Survival and growth remeasured spring 1979.

2-S-68 SITKA SPRUCE COMPARISON OF PLANTING STOCK
LOCATION



2-S-68 - SITKA SPRUCE COMPARISON OF PLANTING STOCK

Results

Planting stock characteristics when planted:

	Mineral soil transplant beds	Cultivated peat transplant beds
Total dry weight (g)	0.82	1.43
Shoot:root ratio	2.1:1	2.0:1
Max. shoot length (cm)	10.1	16.4

Sitka spruce survival:

	Percent Survival	
Date	Mineral soil transplant beds	Cultivated peat transplant beds
Fall 1968	98	84
Fall 1970	98	80
Fall 1972	98	78
Spring 1979	72	76

Sitka spruce growth:

	Total Height (cm)		Leader Length (cm)	
Date	Mineral soil transplant beds	Cultivated peat transplant beds	Mineral soil transplant beds	Cultivated peat transplant beds
Fall 1972	32	32	26	31
Spring 1979	76	78	14	16

2-S-68 - SITKA SPRUCE COMPARISON OF PLANTING STOCK

Assessment of Results

When planted, stock from cultivated peat transplant beds was larger and heavier than stock from mineral soil transplant beds, but shoot:root ratios were similar.

Initial results showed mineral soil stock survived better than cultivated peat stock despite the latter's apparent superiority at time of planting. Most recent results indicate this difference has now disappeared, though this could be due partly to difficulties in locating all planted seedlings at the 1979 remeasurement.

Height growth has been slow. There is no difference in total height between the two stock types, despite an apparent superiority in leader length for the cultivated peat stock for the two remeasurement dates given here.

The use of peat cultivated *in situ*, in conjunction with plastic greenhouses, was tested as an experimental tree seedling production technique in Newfoundland in the late 1960's. Satisfactory seedling and transplant stock was produced in the greenhouse without artificial irrigation faster than in local conventional mineral soil nurseries, but the cost of the technique was not competitive.

Reports and Publications

Hall, J. Peter. 1969. 1968 results of four planting research projects. Can. Dep. Fish. & Forest., Can. Forest. Serv., Internal Report N-18, 15 p.

Hall, J. Peter. 1971. Growth and survival of Sitka spruce seedlings from mineral soil and cultivated peat transplant beds. Can. Dep. Fish. & Forest., Can. Forest. Serv., Internal Report N-40, 10 p.

Hall, J. Peter. 1972. Survival and height of seedlings grown in peat and mineral soil, five years after planting in the field. Nfld. Forest. Res. Centre, File Report. 4 p.

67-27 - SCOTS PINE PLANTING ON SFI SCARIFICATION

A demonstration planting of Scots pine on burned cutover land prepared by SFI scarification. Three separate lots of Scots pine from individual plus-tree seedlots are included.

Site. Somewhat moist sandy loam with a moderate to thick organic layer (10-30 cm) on a flat to gently southeast-sloping valley bottom area. Original black spruce stands were cut in 1957-58 and the area was burned by wildfire in 1961. Ground vegetation consists of ericaceous dwarf-shrubs over moss carpet with scattered young black spruce and aspen, and alder clumps. Site Types 1 and 6 (p. 8-9).

Design. Total of 2 ha in 100 m wide strip scarified by SFI towed by wheeled skidder and producing approximately 0.23 m^2 scalps at 1.8 m spacing. Part of strip left unplanted. Remainder planted in three blocks:

A) Scots pine (origin Kilen, Norway - plus tree II)
- 2-1 bareroot stock - 99 seedlings }
- 1-2 bareroot stock - 225 seedlings } in block 24 m long

B) Scots pine (origin Landvik, Norway - plus tree III)
- 1-2 bareroot stock - 700 seedlings in block 50 m long

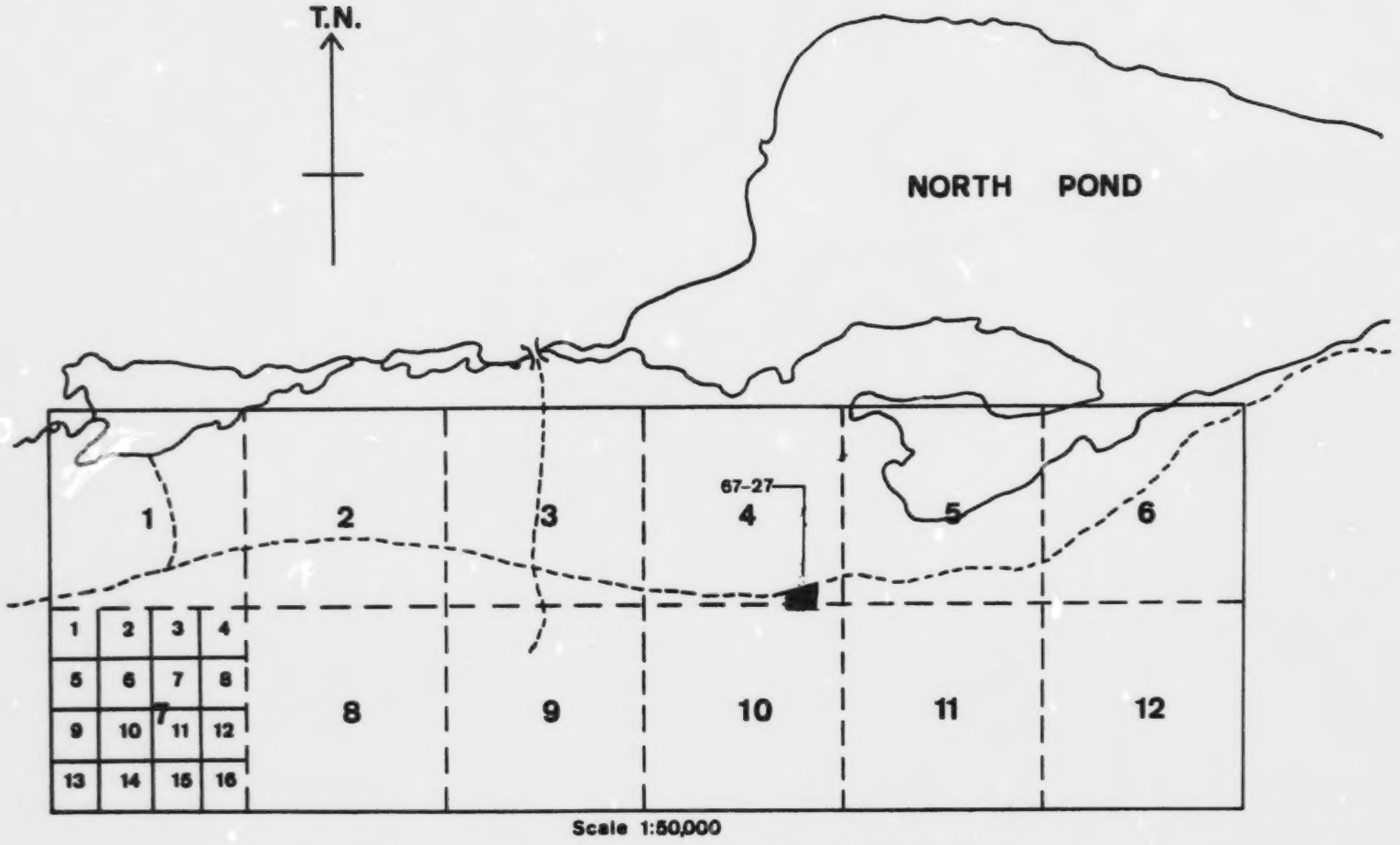
C) Scots pine (origin Landvik, Norway - plus tree II)
- 1-2 bareroot stock - 700 seedlings in block 50 m long.

All planting stock was raised in the North Pond nursery, and planted at about 2.4 m spacing, where possible in SFI scalps.

History. Scarified August 1967.
Planted October 1967.
Survival and height growth measured on 5-10 percent sample of trees, July 1978.

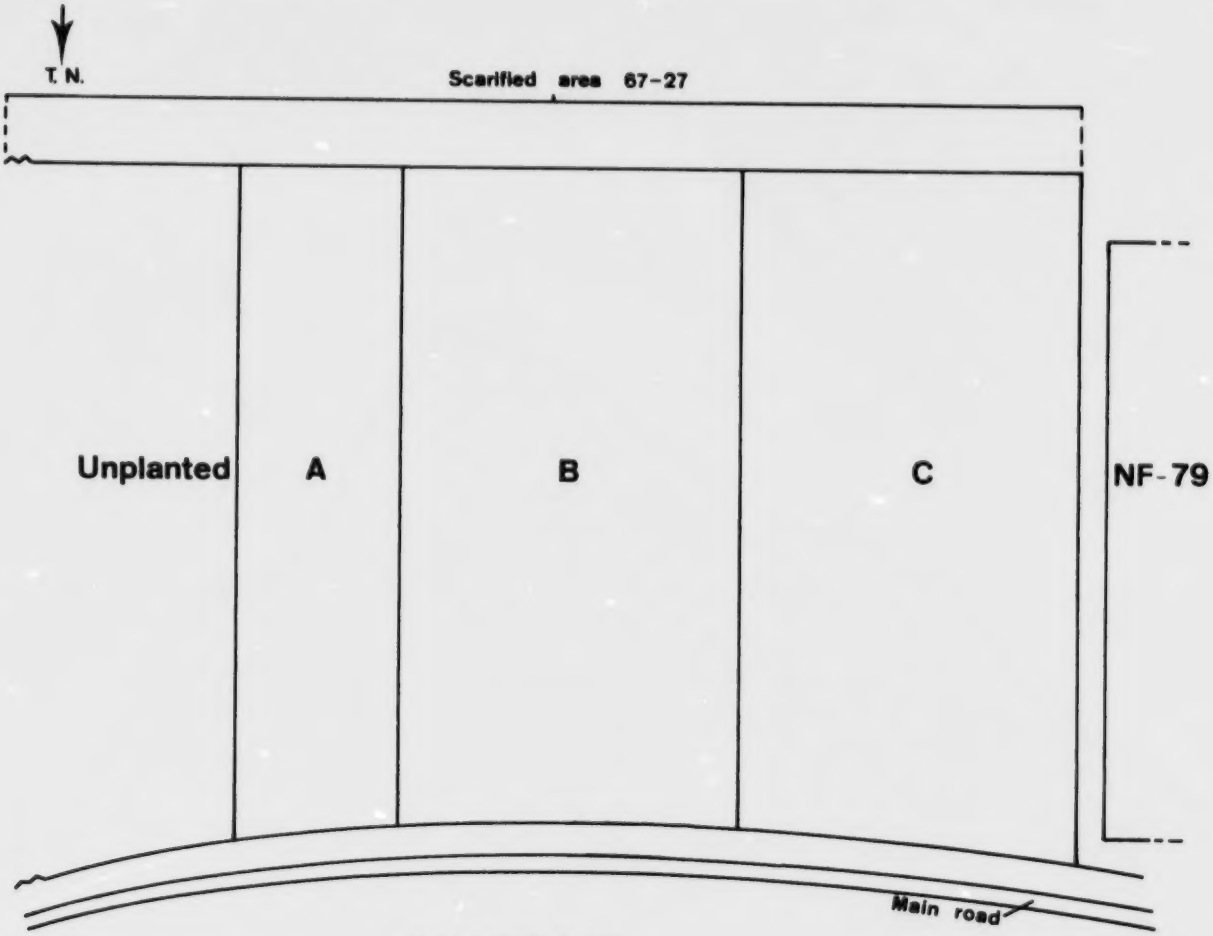
67-27 SCOTS PINE PLANTING ON SFI SCARIFICATION

LOCATION



Scale 1:50,000

67-27 SCOTS PINE PLANTING ON SFI SCARIFICATION LAYOUT



TREATMENT

A - Planted with 1-2 and 2-1 Scots Pine. Kilen, Norway*. (Plus tree II)

B - Planted with 1-2 Scots Pine. Landvik, Norway*. (Plus tree III)

C - Planted with 1-2 Scots Pine. Landvik, Norway*. (Plus tree II)

Scale 1:1000

* Origin

67-27 - SCOTS PINE PLANTING ON SFI SCARIFICATION

Scots pine with alder, aspen and Kalmia competition, July 1978.

Variation in Scots pine growth, February 1981.

67-27 - SCOTS PINE PLANTING ON SFI SCARIFICATION

Results

Scots pine survival and condition, July 1978:

Block	Percentage of Trees							
	Healthy undamaged	Leader damaged	Foliage discolored	Other damage	Live	Dead	Missing	Total
A	22	34	34	0	81	0	19	100
B	9	39	45	39	70	3	27	100
C	6	29	35	39	84	0	16	100

Scots pine growth, July 1978:

Block	Av. height when planted 1967 (cm)	Av. total height 1978 (cm)	Av. 1977 leader (cm)
A	19	124	19
B	20	55	6
C	20	97	15

67-27 - SCOTS PINE PLANTING ON SFI SCARIFICATION

Assessment of Results

Scots pine survival in these plantations has been reasonably good, but very few of the trees are completely healthy and undamaged. Frost damage to leaders resulted in many trees having multiple leaders and caused the loss of one whorl of lateral shoots about 1974-75. Foliage discoloration due to winter drying and/or nutrient deficiencies in the soil has been another problem.

Height growth varies considerably within and between the three blocks. Best growth generally is on higher, drier ground next to the road at the north edge of the plantations and on a low ridge near the south edge. In general, growth has been poor with average annual height increment in the 10 growing seasons since planting only 3.5-10 cm.

Reports and Publications

Nil.

C. TREE IMPROVEMENT

NF-76 - WHITE SPRUCE PROVENANCE TRIAL

A provenance trial comparing the performance of provenances of white spruce from the Great Lakes - St. Lawrence Region of Canada and the adjoining United States. The objective is to identify suitable provenances for Newfoundland.

Site. Original stand of balsam fir - black spruce was clearcut for pulpwood in 1956, then area was burned by wildfire in 1961. Gentle north slope on fresh to wet loamy till soil. Several site types recognized in 1970:

- I - fairly deep dry-moist soil and fairly deep organic layer with pin cherry, aspen, Polytrichum moss and occasional Kalmia. Site Type 1 (p. 8).
- II - widely varying soil depth and moisture with scattered aspen, alder, pin cherry, Polytrichum and Dicranum, and occasional patches of Carex, Vaccinium, Kalmia and Cornus. Site Type 1 (p. 8).
- IIa - as II but with organic layer burned off to expose stones and boulders; dry-moist. Site Type 2 (p. 8).
- IIb - as IIa but with less organic matter burned off. Site Type 2 (p. 8).
- III - wet muck soil with alder, Salix sp. and dense tall Carex, and occasional Sphagnum moss patches. Site Type 2 (p. 8).
- IIIa - wet soil with alders and coarse Carex spp. Site Type 2 (p. 8).

Design. Randomized complete block with six replications of each of 32 provenances, 31 from Great Lakes - St. Lawrence Region consisting of 2-2 seedlings raised at Petawawa National Forestry Institute, Chalk River, Ontario, one from western Newfoundland consisting of 3-5-year old wildings.

Each plot contained 40 trees planted in two rows at 1.8 m spacing.

Two border rows were planted around the experiment.

Total area of experiment is 2.8 ha.

History. Established in spring 1963. Newfoundland wildings planted in fall 1963.

Total height of all trees, and annual leader growth and phenological data on five sample trees per plot recorded fall 1968.

Total height and diameter breast height of five sample trees per plot recorded fall 1973, also heights corresponding to fall 1969, 1970, 1971, 1972, and diameter at half height above 1.3 m.

Total height, diameter breast height and diameter at half height above 1.3 m of eight sample trees per plot recorded fall 1978.

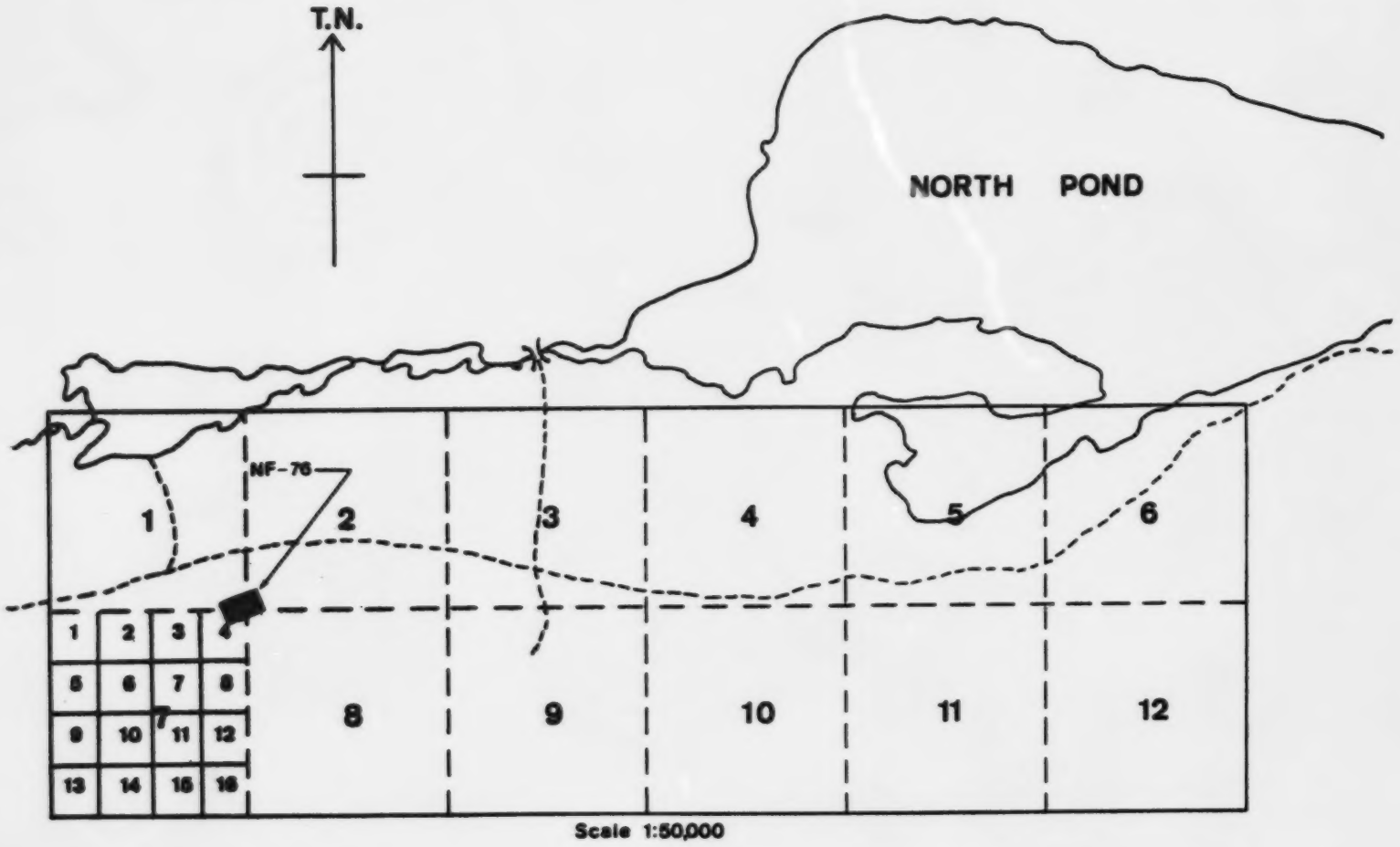
About 50 percent of trees pruned to 1.8 m height, summer 1983.

Access improved, summer 1983.

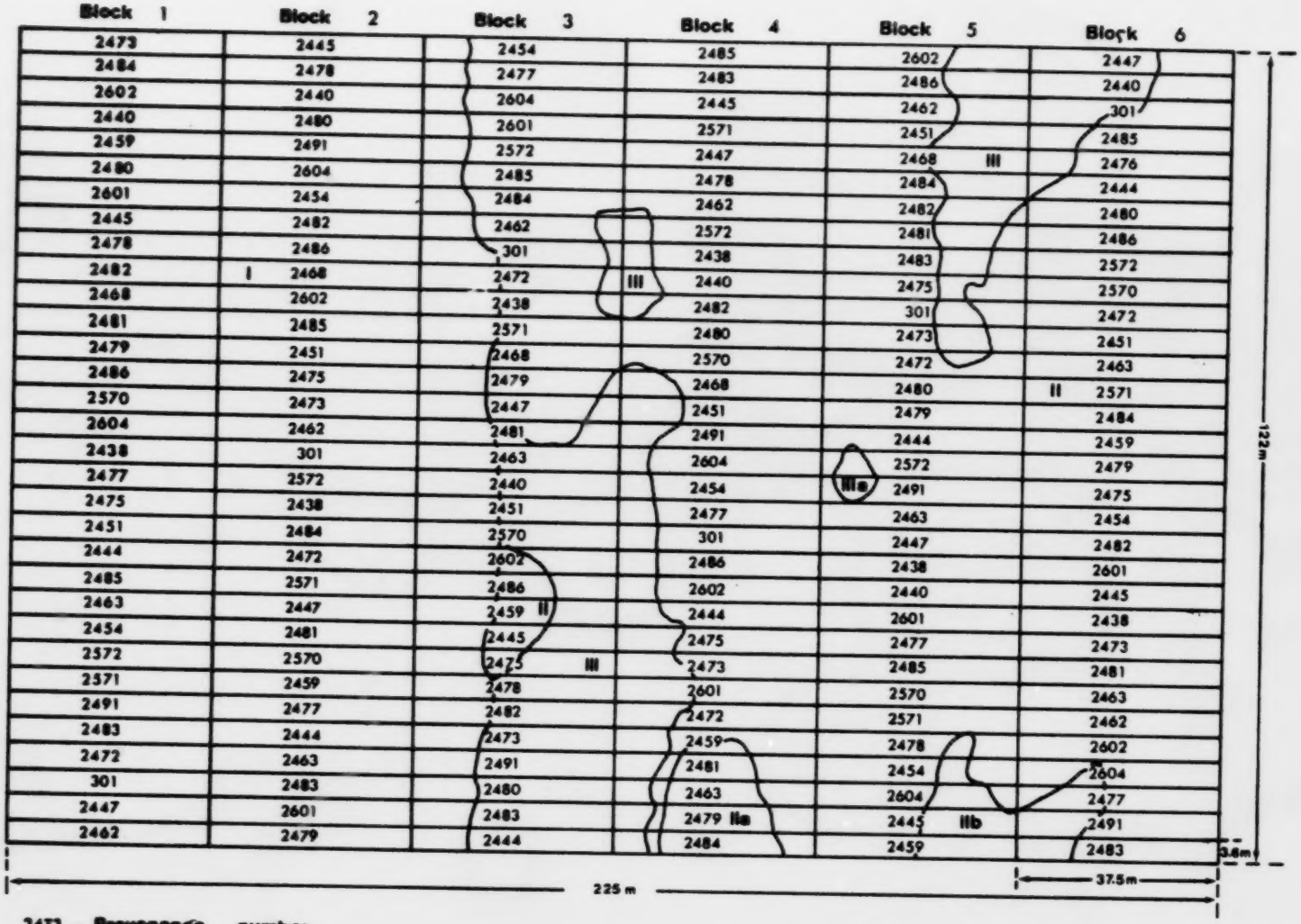
Total height, diameter breast height, form and numbers of cones on all trees recorded fall 1983.

A series of inter- and intra-provenance crosses made on fastest growing provenances and Newfoundland provenance 1980, 1982, 1983.

NF-76 WHITE SPRUCE PROVENANCE TRIAL
LOCATION



NF-76 WHITE SPRUCE PROVENANCE TRIAL
LAYOUT



2473 - Provenance number

II - Site type (see text)

NF-76 - WHITE SPRUCE PROVENANCE TRIAL

Planting stock heeled in during snow storm prior to planting, May 1963.

General view of northeast corner of plantation, after pruning, 1983.

NF-76 - WHITE SPRUCE PROVENANCE TRIAL

Results

Total height and diameter breast height of provenances:

Provenance	Location	Average height (m)			Diameter breast height (cm)	
		10 years from seed	15 years from seed	20 years from seed	15 years from seed	20 years from seed
2447	Grandes Piles, Que.	1.13	2.15	3.09	1.95	4.20
2444	Beachburg, Ont.	1.03	2.05	3.06	1.70	3.78
2462	McNally Lake, Que.	0.96	1.95	2.94	1.54	3.75
2475	Upper Green R[illegible], N.B.	0.96	1.91	2.92	1.55	3.72
2472	Price, Que.	0.92	1.88	2.89	1.50	3.55
2451	Lake Edward, Que.	1.00	2.05	2.84	1.80	3.60
2481	Potter, Ont.	0.96	2.00	2.79	1.56	3.33
2459	Algonquin Park, Ont.	1.09	2.05	2.79	1.78	3.53
2463	Notre Dame du Laus, Que.	1.00	1.96	2.79	1.62	3.57
2477	Ashley Mines, Ont.	0.93	1.90	2.71	1.38	3.08
2473	Edmundston, N.B.	0.90	1.84	2.70	1.31	3.37
2491	Valcartier, Que.	0.91	1.85	2.70	1.42	3.50
2438	Peterborough, Ont.	1.00	1.88	2.68	1.48	3.27
2483	Pagwachuan Lake, Ont.	0.92	1.78	2.68	1.16	3.25
2485	Lac Simard, Que.	0.99	1.95	2.68	1.46	3.12
2445	Cushing, Que.	1.01	1.81	2.66	1.31	3.35
2486	Swastika, Ont.	0.88	1.82	2.64	1.33	3.25
2572	Huron National Forest, Mich.	0.92	1.67	2.61	1.06	3.07
2570	Cheguamegon National Forest, Wisc.	0.90	1.84	2.61	1.40	3.12
2479	Aubrey Falls, Ont.	0.93	1.78	2.61	1.17	2.95
2454	N. Baskatong Lake, Que.	0.94	1.83	2.60	1.32	3.03
2571	Grand Rapids, Minn.	1.00	1.87	2.58	1.35	2.88
2602	Luce Co., Mich.	0.84	1.79	2.57	1.37	3.22
2478	Marten River, Ont.	0.78	1.78	2.57	1.14	2.98
2484	Mitchinamekus Lake, Que.	0.91	1.57	2.46	0.81	2.70
2601	Cook Co., Minn.	0.73	1.54	2.44	0.94	2.75
2468	Searchmont, Ont.	0.91	1.68	2.42	1.05	2.63
2604	Shipshaw River, Que.	0.83	1.70	2.39	0.89	2.53
2482	Kapuskasing, Ont.	0.87	1.70	2.39	1.09	2.67
2480	Kakabeka Falls, Ont.	0.73	1.65	2.36	0.99	2.55
301	Western Newfoundland	0.54	1.38	2.33	0.44	2.45
2440	Napanee, Ont.	0.85	1.62	2.21	0.96	2.47

NF-76 - WHITE SPRUCE PROVENANCE TRIAL

Assessment of Results

The eight fastest-growing provenances at 20 years of age have been identified and are recommended for this region of Newfoundland. They are also provisionally recommended for other regions of the Province. Seven of these eight are also amongst the eight provenances with greatest diameter at 20 years.

All provenances tested in the experiment have similar form and are free from frost and winter damage.

There is a strong correlation between 7-year, 10-year, 15-year and 20-year heights, showing that superior provenances of white spruce can be identified early.

Replications x provenances interaction is highly significant for both height and diameter. Growth could thus be enhanced by using the best provenances on good sites and/or treating them with fertilizer.

Within-provenance genetic variation is significant. Further genetic improvement could be accomplished by selecting superior trees within superior provenances and using seed or cuttings from those trees to create seed orchards. Seed of six best provenances has been collected and, when tested, had 98-100 percent viability.

Reports and Publications

Wilton, W.C. 1964. Establishment Report. White spruce provenance experiment. Can. Dep. Forest., Forest. Res. Br., Mimeo. 64-N-2. 7 p.

Nicholson, J. 1970. Development of white spruce provenances from the Great Lakes - St. Lawrence Forest Region in Newfoundland. Can. Dep. Fish. & Forest., Can. Forest. Serv., Information Report N-X-52. 18 p.

Khalil, M.A.K. 1974. Fifteen years growth of Great Lakes - St. Lawrence Region white spruce (Picea glauca (Moench) Voss) provenances in Newfoundland. Environ. Can., Can. Forest. Serv., Information Report N-X-120. 38 p.

Khalil, M.A.K. 1979. Twenty year results of the Great Lakes - St. Lawrence Region white spruce provenance test in Newfoundland. Environ. Can., Can. Forest. Serv., Information Report N-X-172. 18 p.

Hall, J. Peter. 1979. Trials of exotic species and genetic improvement of larch in Newfoundland. Proc. of the Eighteenth Meeting of the Canadian Tree Improvement Assoc., Part 1, Env. Can., Can. Forest. Serv., Ottawa. p. 216-220.

NF-81 - TRIALS OF EXOTIC SPECIES

The study consists of planting trials of exotic species on a burned cutover to test their suitability as reforestation species.

Site. The planting site formerly had a stand of black spruce and balsam fir. It was clearcut for pulpwood in 1957, then burned by wildfire in 1961. The planting trial is on a gradual easterly slope with stony till soils with generally a clay loam texture. Drainage is moderately good with occasional wet patches.

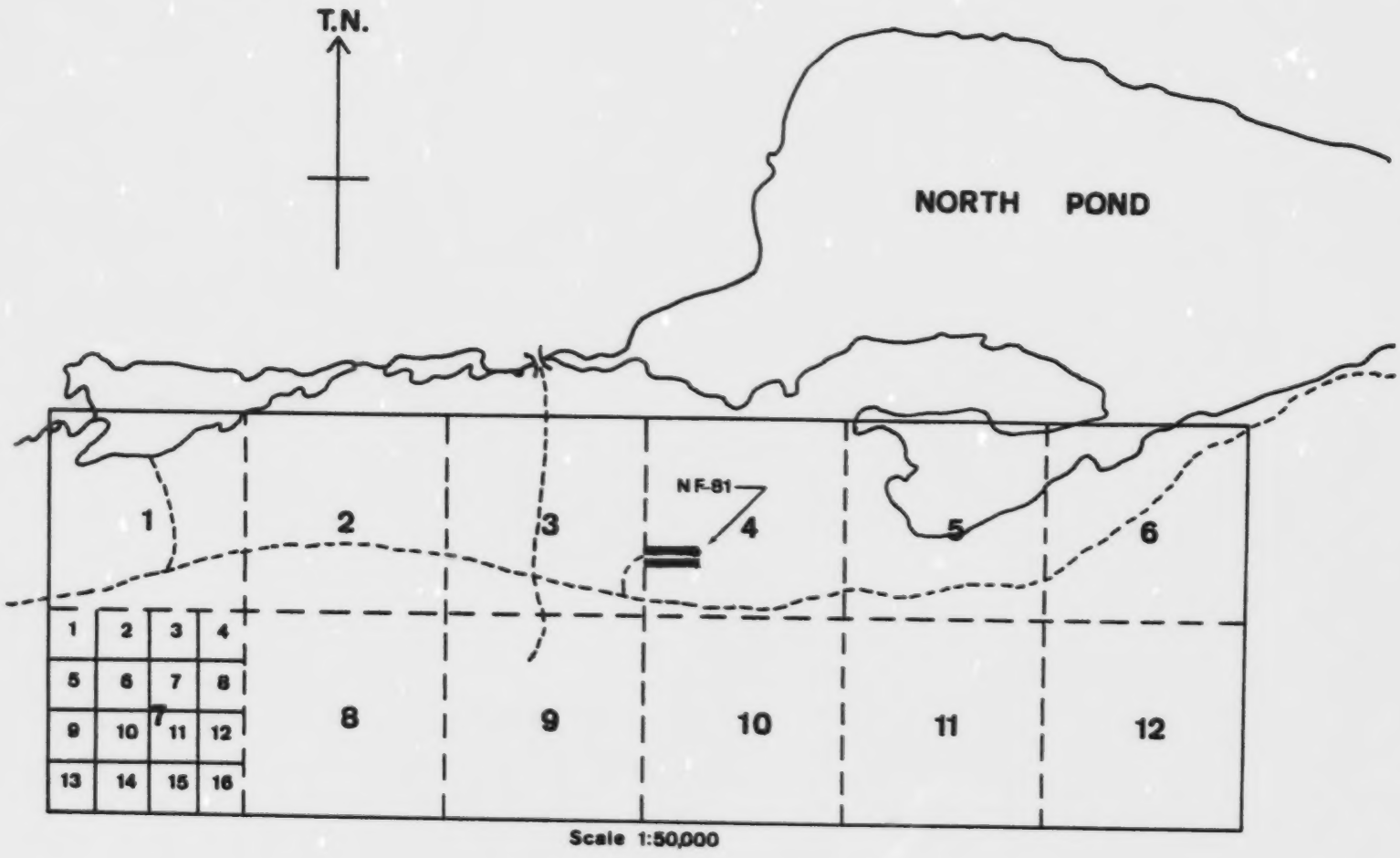
Natural regeneration is composed of black spruce, trembling aspen, white birch and pin cherry and covers most of the area. Some unforested Kalmia patches occur and alder dominates on the wet areas. When planting was done most of the regeneration was less than one metre tall but the regeneration was not cleared, and then only in part, until 11-12 years after planting began. About half of the original planted area has been cleared of competing regeneration.

Design. The plantation consists of a series of 27.4 x 27.4 m plots each containing one species from one origin usually in its natural range. The species are not replicated. Each plot has 100 trees planted at a spacing of 2.4 x 2.4 m and planted using the pit method. The total area originally planted was 4.14 ha of which 1.20 ha are cleared and available for demonstration. Some of the area (0.45 ha) was cleared but the planted trees were too suppressed to yield any useful results.

Pines and spruces were the major species planted, along with some larch, Douglas-fir, birch, cedar and hemlock. Only pine, larch and birch are available for assessment as the others were either suppressed by competing natural regeneration (spruce) or did not survive planting by more than a few years (Douglas fir, cedar and hemlock).

History. Planting began in 1967 and continued until 1971 when competing vegetation on the site made planting difficult. Survival and height were remeasured periodically. In 1980 and 1981 after cleaning to remove competing hardwoods and black spruce natural regeneration, a series of measurements were made to determine average total height of trees 15 years from seed. It was considered that this data would enable some conclusions to be

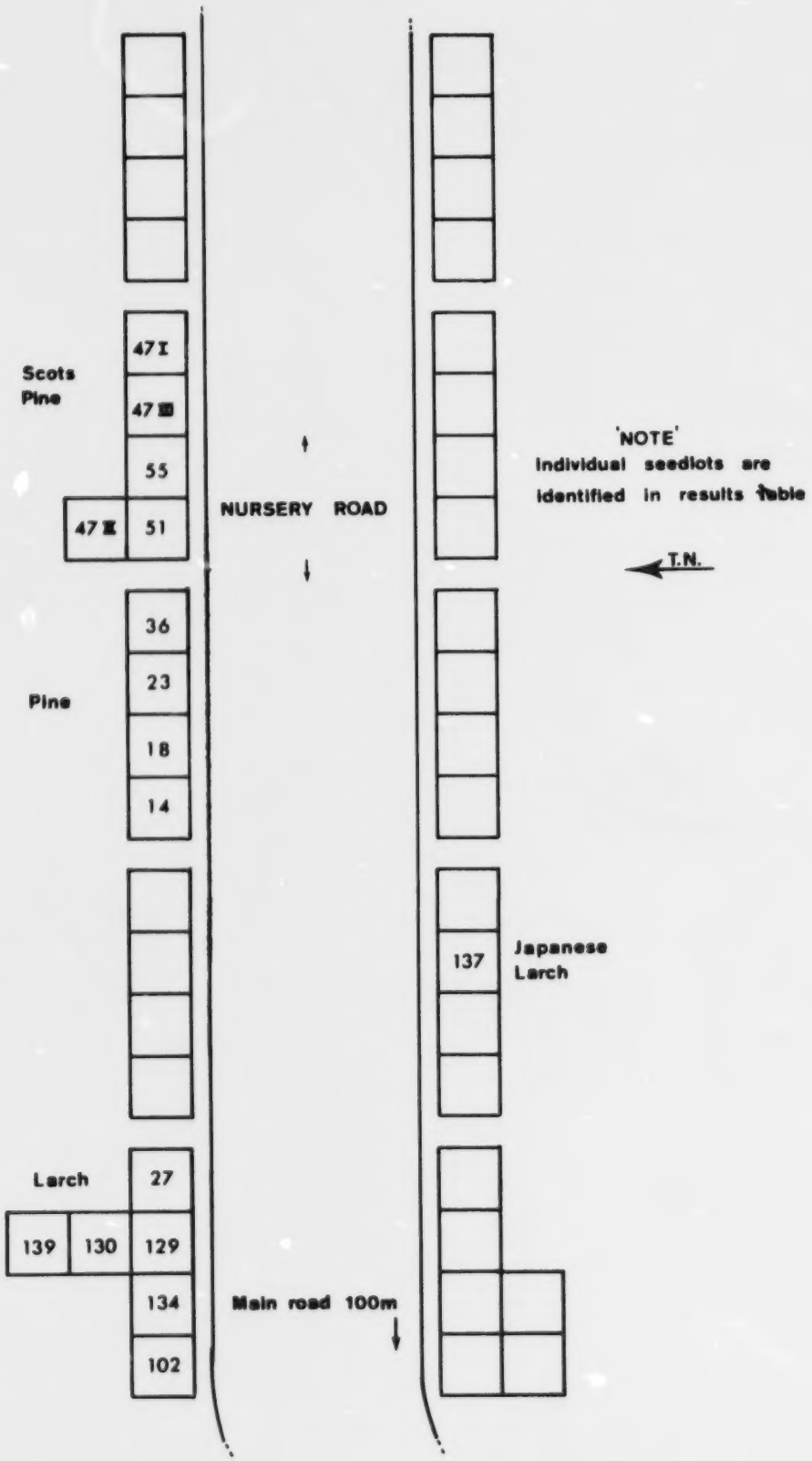
drawn as to the suitability of the species for reforestation. In addition the height and age were determined of the natural black spruce regeneration on the site. This was done in order to have a standard against which to measure the progress of the exotics. It would be a more realistic measure than that of the planted black and white spruce which had been suppressed for many years by the natural regeneration.



NF-81 TRIALS OF EXOTIC SPECIES
LOCATION

NF-81 TRIALS OF EXOTIC SPECIES

LAYOUT



NF-81 - TRIALS OF EXOTIC SPECIES

Cleared plot of Scots pine, February 1979, 10 years after planting.

Good growth of Larix laricina, uncleared plot, September 1976, 10 years after planting.

NF-81 - TRIALS OF EXOTIC SPECIES

Results

Survival and growth:

Seedlot No.	Trees Planted		Percent Survival After		Avg. total height 15 yrs from seed[2,3]
	Scientific name	Common name	5 years[1]	10 years	
14	Pinus resinosa	red pine	43(8)	38	1.27
23	P. banksiana	jack pine	100(12)	96	3.27
18	P. contorta	lodgepole pine	59(1)	59	2.38
36	P. monticola	western white pine	17(2)	3	0.51
51	P. sylvestris	Scots pine	89(10)	79	1.59
55	P. sylvestris	Scots pine	91(18)	85	1.93
47II	P. sylvestris	Scots pine	97 -	84	1.24
47III	P. sylvestris	Scots pine	97 -	94	1.84
48I	P. sylvestris	Scots pine	100 -	100	2.22
27	Larix laricina	tamarack (juniper)	100(3)	91	4.68
129	L. kaempferi	Japanese larch	29 -	27	3.03
130	L. kaempferi	Japanese larch	43 -	23	3.64
139	L. kaempferi	Japanese larch	26 -	23	2.45
102	L. decidua	European larch	56 -	52	2.16
134	L. decidua	European larch	68 -	64	1.86
137	Betula ermannii	Japanese birch	97(4)	82	1.96

[1]Most mortality occurred in the first two years from planting. After two years some of the dead trees were replaced; the number replaced is shown in brackets.

[2]Since most of the trees were aged 2 + 2 when planted the percent survival 10 years after planting and 15 years from seed are quite similar.

[3]The average height of black spruce natural regeneration was 4 m at 15 years of age.

NF-81 - TRIALS OF EXOTIC SPECIES

Assessment of Results

Survival was quite variable - good for pine except monticola, resinosa and contorta; poor for larches except laricina.

Height growth was best for the larches, especially laricina. The black spruce natural regeneration was about 4 m tall and only the L. laricina is that tall.

In considering the exotics for reforestation on a large scale - only P. banksiana of the pines appears to have any promise. Scots pine survives well but cannot even closely match the growth of black spruce. The larches may be suitable if problems of early mortality can be overcome. L. laricina has outgrown black spruce and one of the Japanese larches (130) is the second tallest of all species planted. The Japanese birch survives well but does not grow well so it is doubtful if this species should be considered for reforestation.

Reports and Publications

Hall, J. Peter. 1973. Survival and growth of exotic tree species in Newfoundland. Environ. Can., Can. Forest. Serv., Information Report N-X-85. 23 p.

Hall, J. Peter. 1982. Growth and development of exotic tree species in Newfoundland. Environ. Can., Can. Forest. Serv., Information Report N-X-212. 36 p.

Hall, J. Peter. 1982. Trials of exotic species and genetic improvement of larch in Newfoundland. Proc. of the Eighteenth Meeting of the Canadian Tree Improvement Assoc., Part 1, Env. Can., Can. Forest. Serv., Ottawa. p. 216-220.

Hall, J. Peter. 1983. Comparison of the growth of larch with the conifers in reforested and afforested sites in Newfoundland. Forest. Chron. 59(1):14-16.

NF-88 - RED SPRUCE PROVENANCE TRIAL

A provenance trial comparing the performance of provenances of red spruce from the Acadian Forest Region of Canada and the States of Maine and West Virginia in the United States. The objective is to identify suitable provenances for Newfoundland.

Site. Original stand of balsam fir - black spruce - white birch was clearcut for pulpwood in 1958, prior to the area being burned by wildfire in 1961. Site is flat with well-drained stony sandy loam soil overlain by 5-8 cm deep organic layer. Ground vegetation was virtually absent at time of establishment. The site now has a moss carpet with aspen reproduction (which has been removed by cutting) and scattered ericaceous dwarf-shrubs. Site Type 1 (p. 8).

Design. Randomized complete block with 10 replications of each of 30 provenances.

Experiment was established with 2-2 seedlings raised at Acadia Forestry Station, near Fredericton, New Brunswick and planted in 4-tree square plots at 1.8 m spacing.

There are four rows of border trees planted at the same spacing.

Total area of experiment is 1.9 ha.

History. Plantation established in spring 1964.

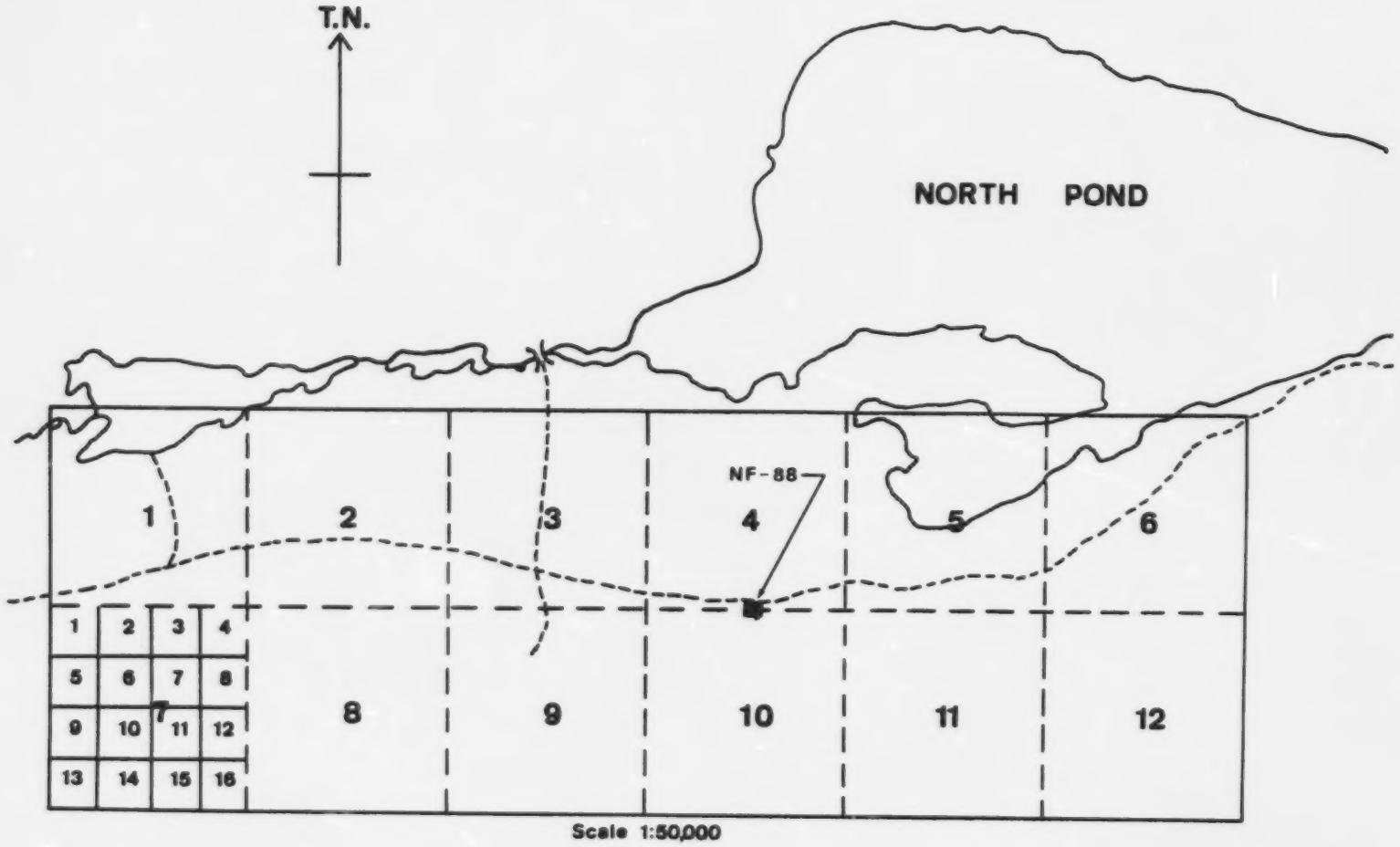
Dead trees replaced in spring 1965.

Total height, annual height growth for previous three years, root-collar diameter and phenological data recorded on all trees in 1972.

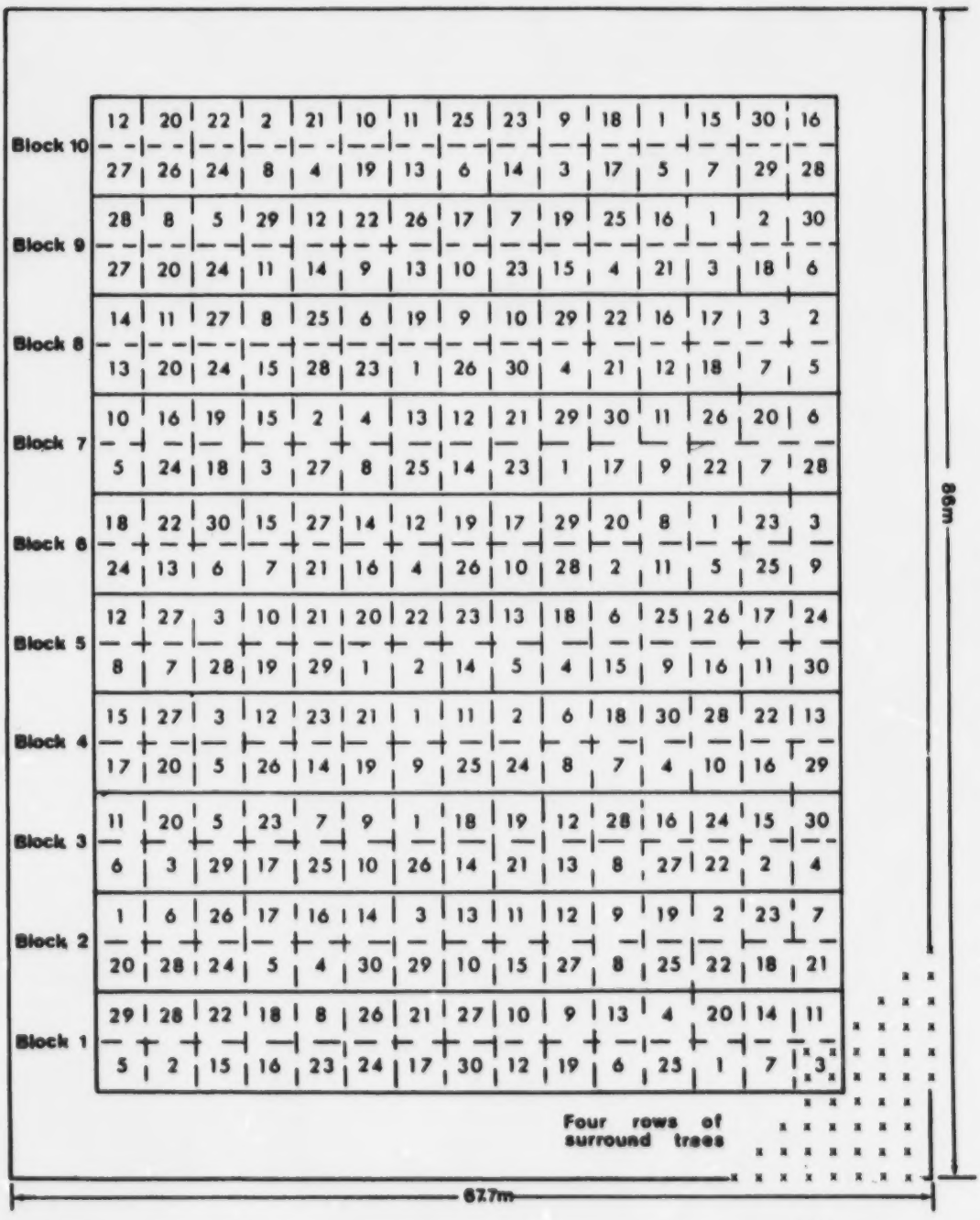
Total height and diameter at 0.6 m recorded on all trees in fall 1979.

Series of controlled pollinations using black spruce, white spruce and red spruce pollen made on eight red spruce mother trees to assess the effects of hybridization with these species 1980.

NF-88 RED SPRUCE PROVENANCE TRIAL
LOCATION



NF-88 RED SPRUCE PROVENANCE TRIAL
LAYOUT



3 - Provenance number
x - Planted Red Spruce trees

NF-88 - RED SPRUCE PROVENANCE TRIAL

General view of plantation from NE corner, August 1979 (during CTIA field tour).

General view of plantation from SE corner, February 1981.

NF-88 - RED SPRUCE PROVENANCE TRIAL

Results

Total height and diameter of provenances:

Provenance	Location	Average height (m) 11 years from seed	14 years from seed	21 years from seed	Root collar diameter (cm) 14 years from seed	Diameter at 0.6 m 21 years from seed
14	Upper Blackville, N.B.	0.81	1.40	2.34	4.0	3.7
17	Boyne Road, Sunbury Co., N.B.	0.77	1.30	2.15	4.0	3.4
30	Mushamuch & Spondo Lakes, Lunenburg Co., N.S.	0.80	1.32	2.13	4.2	3.5
16	Acadia Forestry Sta., Fredericton, N.B.	0.88	1.39	2.03	4.0	3.3
20	South Paradise, Annapolis Co., N.S.	0.77	1.22	2.03	4.0	3.1
29	Nictau West, Annapolis Co., N.S.	0.70	1.17	1.96	3.6	3.0
18	Lakelands, Cumberland Co., N.S.	0.70	1.21	1.95	3.8	3.0
3	Timber Lake, Lunenburg Co., N.S.	0.73	1.16	1.94	4.0	3.0
15	Rocky Brook, York Co., N.B.	0.76	1.23	1.92	4.1	3.1
28	Little Black River, Maine	0.71	1.14	1.92	3.6	3.1
13	New River Watershed, Charlotte Co., N.B.	0.71	1.13	1.82	3.6	3.0
1	Napadogan, York Co., N.B.	0.61	1.04	1.79	3.4	2.8
5	Scotts Bay, Kings Co., N.B.	0.65	1.08	1.77	3.6	2.6
12	Monongahela National Forest, W. Virginia	0.77	1.19	1.76	3.9	2.8
27	Evans Brook, Annapolis Co., N.S.	0.71	1.08	1.75	3.7	2.8
4	Sisters Brook, York Co., N.B.	0.68	1.10	1.74	3.7	2.7
19	Chezzetcook, N.S.	0.65	1.06	1.74	3.6	2.6
9	Hart's Lake, Colchester Co., N.S.	0.60	1.01	1.73	3.4	2.6
6	Corberrie, Digby Co., N.S.	0.65	1.06	1.72	3.6	2.7
2	Great Salmon River, Saint John Co., N.B.	0.69	1.12	1.70	3.7	2.8
26	Penobscot Forest Experiment Station, Maine	0.53	0.95	1.66	3.0	2.4
21	Blanchard, Pictou Co., N.S.	0.62	1.07	1.66	3.4	2.7
23	West of Five Mile Lake, Hants Co., N.S.	0.64	1.07	1.62	3.6	2.4
7	Waverley, Halifax Co., N.S.	0.59	1.01	1.58	3.2	2.3
24	Crooked Creek, Albert Co., N.B.	0.61	1.00	1.58	3.6	2.5
22	Snare Lake, Colchester Co., N.B.	0.62	1.04	1.51	3.6	2.3
25	West of Great Salmon River, Saint John Co., N.B.	0.59	0.94	1.48	3.3	2.1
10	Economy River, Colchester Co., N.S.	0.57	0.96	1.47	3.2	2.0
8	Headwaters, East Sheet Harbour River, N.S.	0.59	0.98	1.44	3.4	2.3
11	Canaan Mountain, West Virginia	0.62	0.96	1.42	3.4	2.2

NF-88 - RED SPRUCE PROVENANCE TRIAL

Assessment of Results

The six fastest-growing provenances at 21 years of age have been identified. Five of these six are also amongst the six provenances with greatest diameter at 0.6 m at 21 years. No provenances have proven superior to black spruce in the area, but some of the better all spruce provenances merit further study in better sites.

There are highly significant correlations between heights in 1969, 1972 and 1979, showing that these provenances are stable, and that superior provenances can be identified early. There is, however, wide within-provenance variation.

Replications x provenances interaction is highly significant for both height and diameter. Growth could be enhanced by growing the best provenances on good sites and/or with fertilization treatments.

Reports and Publications

Wilton, W.C. 1965. Establishment report. Red spruce provenance experiment. Project NF-88, Can. Dep. Forest., Forest. Res. Br., Mimeo. 65-N-4. 6 p.

Khalil, M.A.K. 1974. Preliminary results of a red spruce (Picea rubens Sarg.) provenance experiment in Newfoundland. Environ. Can., Can. Forest. Serv., Information Report N-X-117. 45 p.

Khalil, M.A.K. 1981. Twenty year results of the red spruce provenance study in Newfoundland. Environ. Can., Can. Forest. Serv., Information Report N-X-191. 26 p.

4-S-66 - PLANTATION TRIAL OF PINUS SPP.

A plantation trial of several pines on a burned cutover to test their suitability as reforestation species.

Site. The site formerly supported a mixed stand of black spruce and balsam fir with scattered white birch and white pine. The site was clearcut for pulpwood in 1957, then burned by wildfire in 1961. The plantation is on a southeasterly slope on deep well-drained podzolic till soils with sandy loam and clay loam texture. Natural regeneration consists of black spruce, white birch and trembling aspen. Alder is present in patches and white spruce occurs occasionally. In 1977, most natural regeneration was approximately the same height (3 m) as the best of the planted trees. Parts of the plantation are dominated by Kalmia vegetation and a thick layer of raw humus. This has affected growth but not survival. Site Types 3 and 6 (p. 8-9).

Design. The plantation consists of 64 plots (15.3 x 30.6 m) arranged in a randomized complete block design.

Each plot contains 128 trees and each seedlot is replicated eight times.

Planting was by the pit planting method and spacing was 1.8 m.

Total plantation area is 3 ha.

The following species, all two years old, were planted:

Pinus resinosa Ait., red pine - Petawawa National Forestry Institute, Ont.

Pinus banksiana Lamb., jack pine - Newcastle, Northumberland Co., N.B.

Pinus contorta Dougl., lodgepole pine Long Beach, Washington, U.S.A.

Pinus sylvestris L. (55), Scots pine - Speymouth Forest, Moray, Scotland

Pinus sylvestris L. (51), Scots pine - Kuorevesi, Finland

Pinus nigra Arn. v. corsicana Loud., Corsican pine - Sherwood For., Nottinghamshire, U.K.

Pinus cembra L., stone pine - Bowring Park, St. John's, Nfld.

Pinus albicaulis Engelm., whitebark pine - Cranbrook, B.C.

History. Plantation established October 1966.

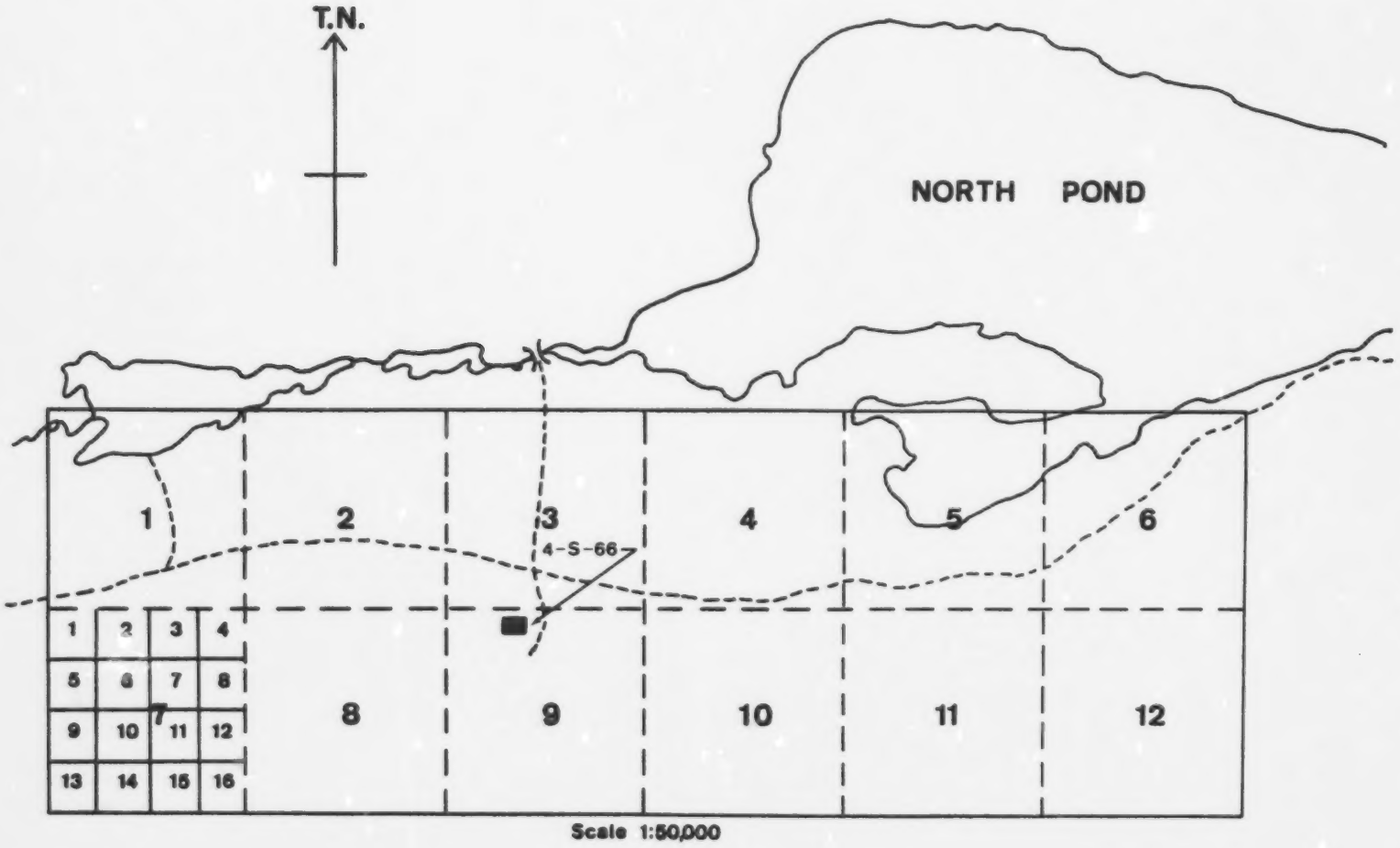
Remeasured for survival when the trees were four years old, fall 1968.

Remeasured for survival and height when the trees were 7, 12 and 15 years old, fall 1971, 1976, 1979.

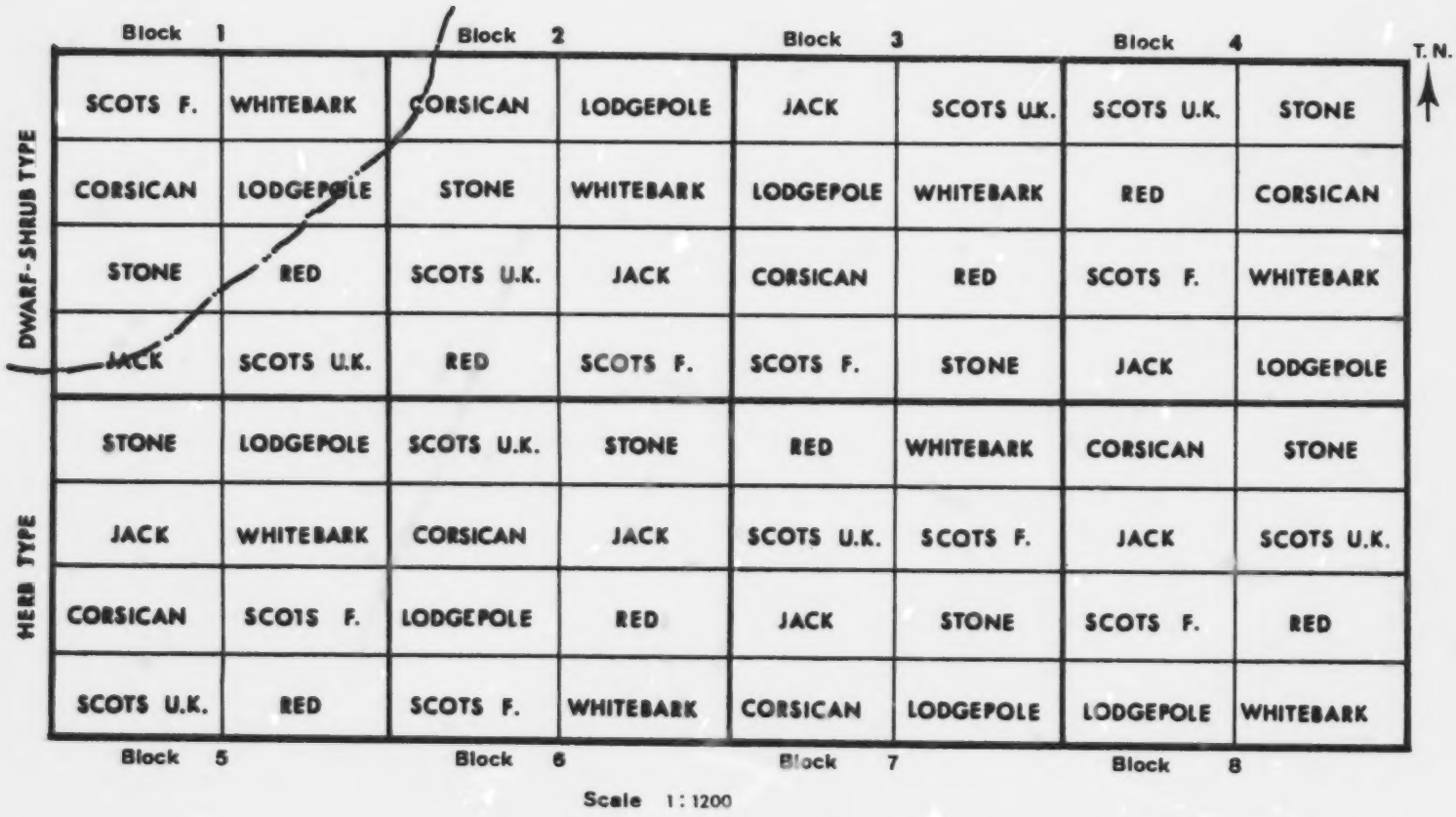
Competing black spruce, white birch, aspen and alder cleared, except in plots containing the three species which had very poor survival, 1980.

4-S-66 PLANTATION TRIAL OF PINUS SPECIES

LOCATION



4-S-66 PLANTATION TRIAL OF PINUS SPECIES
LAYOUT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Block 2
Block 3
Block 4
T. N.
DWARF-SHRUB TYPE
HERB TYPE
SCOTS F. WHITEBARK CORSICAN LODGEPOLE JACK SCOTS U.K. SCOTS U.K. STONE
CORSICAN LODGEPOLE STONE WHITEBARK LODGEPOLE WHITEBARK RED CORSICAN
STONE RED SCOTS U.K. JACK CORSICAN RED SCOTS F. WHITEBARK
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CORSICAN SCOTS F. LODGEPOLE RED JACK STONE SCOTS F. RED
SCOTS U.K. RED SCOTS F. WHITEBARK CORSICAN LODGEPOLE LODGEPOLE WHITEBARK
Block 5
Block 6
Block 7
Block 8

Scale 1 : 1200

Growth of red pine (foreground) and Scots pine (U.K.) (background) near SE corner of plantation, July 1981, 17 growing seasons from seed.

Very poor growth and heavy browsing damage on Pinus albicaulis, February 1979, 14 growing seasons from seed.

4-S-66 - PLANTATION TRIAL OF PINUS SPP.

Results

Survival:

Species	Percentage Survival			
Total Age	4	7	12	15
Yrs. since planting	2	5	10	13
Red pine	79.7b[1]	77.9b	75.9b	73.9b
Jack pine	96.2a	95.7a	94.2a	93.6a
Lodgepole pine	90.2a	90.2a	86.0a	83.0b
Scots pine (UK)	97.0a	97.0a	96.3a	96.3a
Scots pine (Finland)	95.8a	94.9a	93.2a	93.2a
Corsican pine	63.7c	59.4c	26.5d	-[2]
Stone pine	74.3b	69.4b	55.9c	-
Whitebark pine	73.7b	45.6d	7.1e	-

[1]Means followed by the same letter are not significantly different at the 0.95 level of probability.

[2]Measurements discontinued.

Height growth:

Species	Average Total Height (m)			
Total Age	2	7	12	15
Yrs. since planting	0	5	10	13
Red pine	0.09[1]	0.43c[2]	1.14c	1.84c
Jack pine	0.13	1.02b	2.50b	3.58b
Lodgepole pine	0.06	0.81a	1.56a	2.39a
Scots pine (UK)	0.11	0.73a	1.73a	2.50a
Scots pine (Finland)	0.11	0.67a	1.68a	2.70a
Corsican pine	0.13	0.39c	0.49[3]	-[4]
Stone pine	0.05	0.12d	0.34[3]	-
Whitebark pine	0.04	0.13d	0.36[3]	-

[1]Means not tested.

[2]Means followed by the same letter are not significantly different at the 0.95 level of probability.

[3]Not tested.

[4]Measurements discontinued.

4-S-66 - PLANTATION TRIALS OF PINUS SPP.

Assessment of Results

The different microsites on the site have resulted in wide variation in growth rates which is not apparent from the overall means. The best of the pine species grows as well as natural regeneration on the site but the growth of the pines is not superior to native black spruce.

Red pine is the only native pine in the trial and has been outgrown by jack, lodgepole and Scots pine. On the sites tested it is not a suitable species for reforestation. Jack pine, Scots pine and lodgepole are all suitable species for reforestation but their use is unlikely to result in any increase in productivity over using black spruce.

Reports and Publications

Hall, J. Peter. 1969. Initial survival and development of eight pine species planted in central Newfoundland. Can. Dep. Fish. & Forest., Can. Forest. Serv., Information Report N-X-38. 15 p.

Hall, J. Peter. 1972. Five-year survival and height development of eight pine species planted in central Newfoundland. Environ. Can., Can. Forest. Serv., Information Report N-X-75, 15 p.

Hall, J. Peter. 1977. Survival and growth of exotic Pinus species in central Newfoundland ten years after planting. Environ. Can., Can. Forest. Serv., Information Report N-X-154. 12 p.

Hall, J. Peter. 1980. Tree improvement in Newfoundland 1977-79. In Proceedings of the seventeenth meeting of the Canadian Tree Improvement Association, Part I. Env. Can., Canadian Forest. Serv., Ottawa. pp. 69-73.

Hall, J. Peter. 1982(a). Trials of exotic species and genetic improvement of larch in Newfoundland. In Proceedings of the eighteenth meeting of the Canadian Tree Improvement Association. Env. Can., Can. Forest. Ser., Ottawa. pp. 216-220.

Hall, J. Peter. 1982(b). Growth and development of exotic tree species in Newfoundland. Env. Can., Can. Forest. Ser., Information Report N-X-212. 36 p.

13-S-67 - SITKA SPRUCE PROVENANCE TRIAL

A provenance trial comparing the performance of 10 provenances of Sitka spruce from Alaska, through British Columbia and Washington to Oregon, as well as representative provenances of white and black spruce. This is one of a series of nine similar trials established throughout Newfoundland. The objective is to identify suitable provenances for Newfoundland.

Site. Fresh, well-drained sandy loam on a gentle east slope. Original balsam fir - black spruce stand cutover for pulpwood in late 1950's, before burning by wildfire in 1961. Ground vegetation of moss carpet with herbs and natural regeneration of aspen, white birch, pin cherry and black spruce, as well as scattered alders. Site Type 3 (p. 8).

Design. Randomized complete block with eight replications of each of 12 provenances.

Experiment was established with 2-2 seedlings sown at Acadia Forestry Station, near Fredericton, New Brunswick, transplanted at Pasadena in western Newfoundland, and planted in 16-tree square (4 x 4) plots at 1.8 m spacing.

There are two rows of border trees planted at the same spacing.

Total area of experiment is 0.6 ha (93.3 m x 64.0 m).

History. Site cleared in fall 1968.

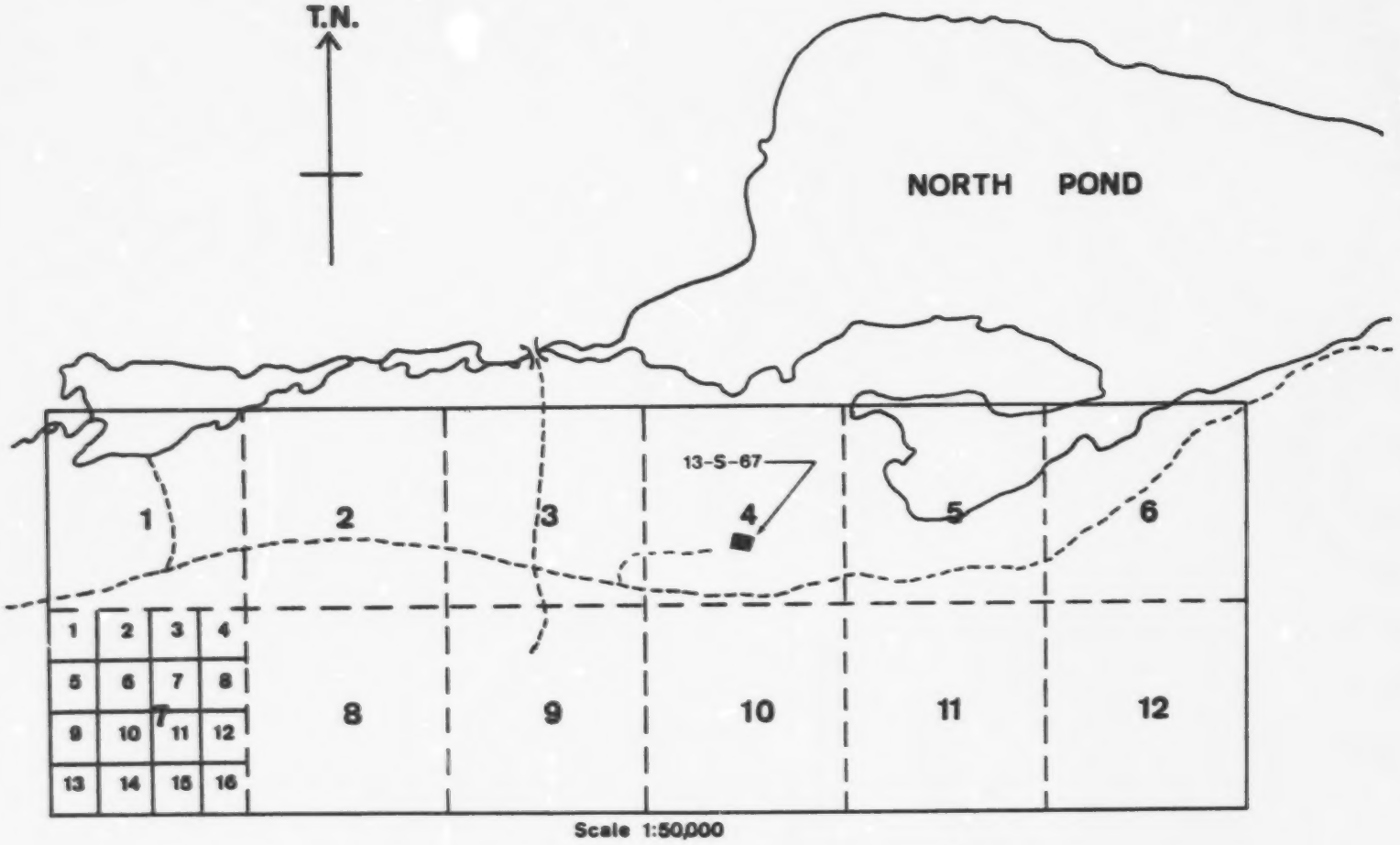
Plantation established in spring 1969.

Dead trees replaced in 1970.

Survival, and winter and Armillaria damage tallied, and height and root collar diameter measured on all trees in fall 1974.

Site cleared of competing vegetation and trees remeasured for height and diameter 1981.

13-S-67 SITKA SPRUCE PROVENANCE TRIAL
LOCATION



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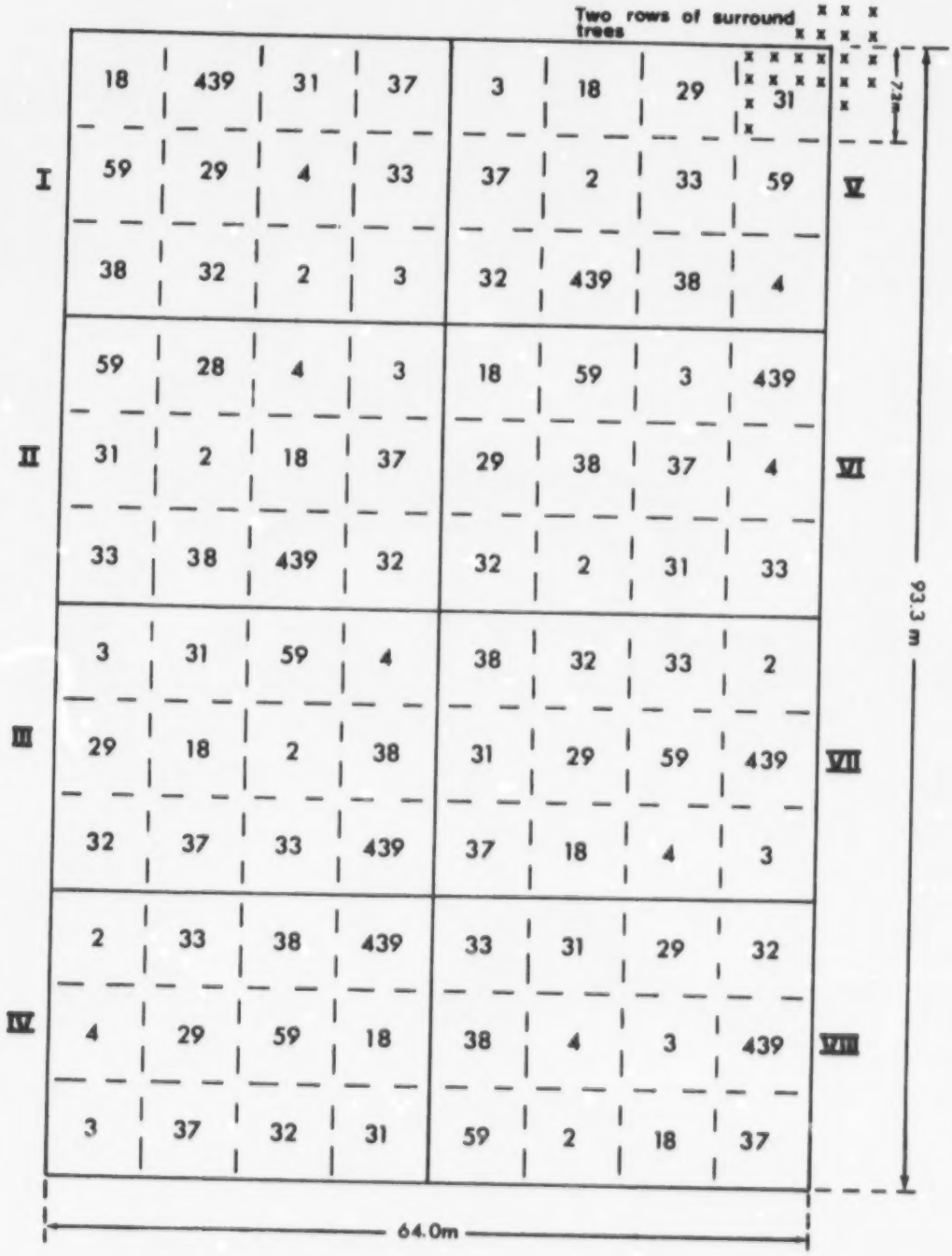
13-S-67 SITKA SPRUCE PROVENANCE TRIAL
LAYOUT



x - Planted trees
3 - Provenance number
II - Block number

T.N.

13-S-67 - SITKA SPRUCE PROVENANCE TRIAL

14-year-old Sitka spruce seedling in trial, March 1979.

13-S-67 - SITKA SPRUCE PROVENANCE TRIAL

Results

Height, winter damage and Armillaria infection of provenances:

Provenance	Location	Mean height (cm) 10 years from seed	Frost damage 1971, 1972 percent	Armillaria mellea infection percent
Sitka spruce				
4	Bella Coola, B.C.	58.1	73.4	9.4
18	Aberdeen, Washington	52.5	73.4	14.1
38	Masset, Queen Charlotte Is., B.C.	49.7	68.8	10.9
29	Nass River Valley, B.C.	49.0	56.3	1.6
33	Kitimat, B.C.	47.2	64.1	9.4
2	Skeena Valley, B.C.	45.7	29.7	3.1
37	Sitka, Alaska	43.8	60.9	1.6
32	Pellant Creek, Queen Charlotte Is., B.C.	41.9	79.7	6.3
31	Yakoun River Valley, Queen Charlotte Is., B.C.	40.5	70.3	23.4
3	Cascade Head, Oregon	*	40.6	48.4
Black spruce				
59	Badger, Newfoundland	66.1	3.1	4.7
White spruce				
439	Acadia Forestry Station, N.B.	43.6	4.7	4.7

*Provenance with no measurable seedlings.

13-S-67 - SITKA SPRUCE PROVENANCE TRIAL

Assessment of Results

There was statistically significant variation among provenances in initial survival, percentage Armillaria root rot infection, percentage winter damage, height and root-collar diameter.

Initial survival was high but growth has been slow, poorer than in any of the other Sitka spruce provenance trials in Newfoundland. No Sitka spruce provenance has grown as well as the black spruce provenance.

Winter damage incidence in 1970-71 or 1971-72 was high for all Sitka spruce provenances except two (which is probably the least maritime-influenced of the northern provenances) for which it was light. Seedlings were killed back to snow level.

Infection by Armillaria root rot was low in most provenances, but severe in two Sitka spruce provenances (3 and 31). There were no statistically significant differences between any provenances in this factor.

Reports and Publications

Khalil, M.A.K. 1977. Provenance experiments in Sitka spruce in Newfoundland. Forest. Chron. 53(3):150-154.

DEMONSTRATION SEED PRODUCTION AREAS

Seed Production Areas (SPA) are young (< 20 years) even-aged forests which are managed for the production of seed. They provide a steady supply of seed from a known (and possibly tested) source and are managed to maintain good growth rates, for protection and accessibility. In order to demonstrate the management, methods and functions of SPA, demonstration areas were established by the CFS at North Pond in 1977.

Site. The site of the SPA formerly supported a mixed stand of balsam fir and black spruce prior to clearcutting in 1957. In 1961 the area was burned by wildfire and subsequently regenerated to black spruce, white birch, trembling aspen, pin cherry and alder. The site is an easterly slope with stony till soils and a clay loam texture. Drainage is moderately good with occasional wet patches dominated by alder. Occasional unforested patches covered with Kalmia are also present.

Design. The demonstration areas have no particular design but consist of cleared patches in strips running approximately 30 m deep along the main road. The total cleared area is approximately 1.66 ha. The site was cleared using brushcutters and all hardwood species were removed. Then patches of spruce were broken up and thinned to a minimum spacing of 2.4 m or 1 681 stems/ha. Since there are scattered open patches with no softwoods the actual density is less.

Three site types, typical of the area, designated 1, 2 and 3, were selected as test sites.

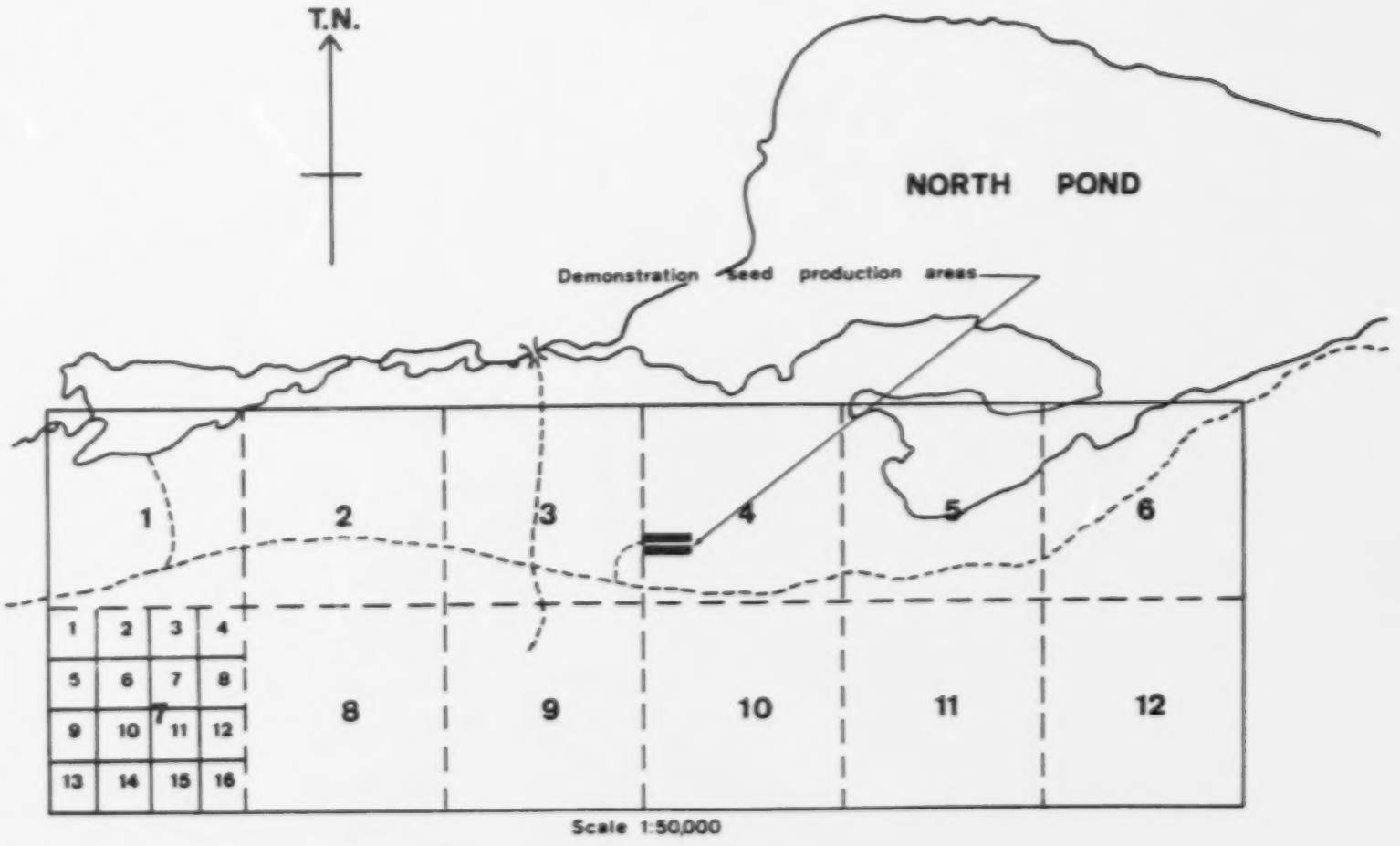
Site 1. This site was dominated by trembling aspen and white birch with black spruce in scattered clumps. The spruce, averaging 3 m in height, was thinned to a spacing of 2.4 m leaving much of the site unstocked to softwoods.

Site 2. This site contained only densely spaced black spruce averaging 2 m in height. Patches of Kalmia and Vaccinium were present. Approximately 90 percent of the black spruce stems were removed to get an average spacing of 2.4 m.

Site 3. This site had the best growth of the three with the black spruce averaging 4 m in height. It also had more black spruce and fewer hardwoods than site 1.

History. After establishment the cone crops have been sampled on all three sites from 1978 to 1983. In 1981 the trees produced so few cones that it was not worth making a collection.

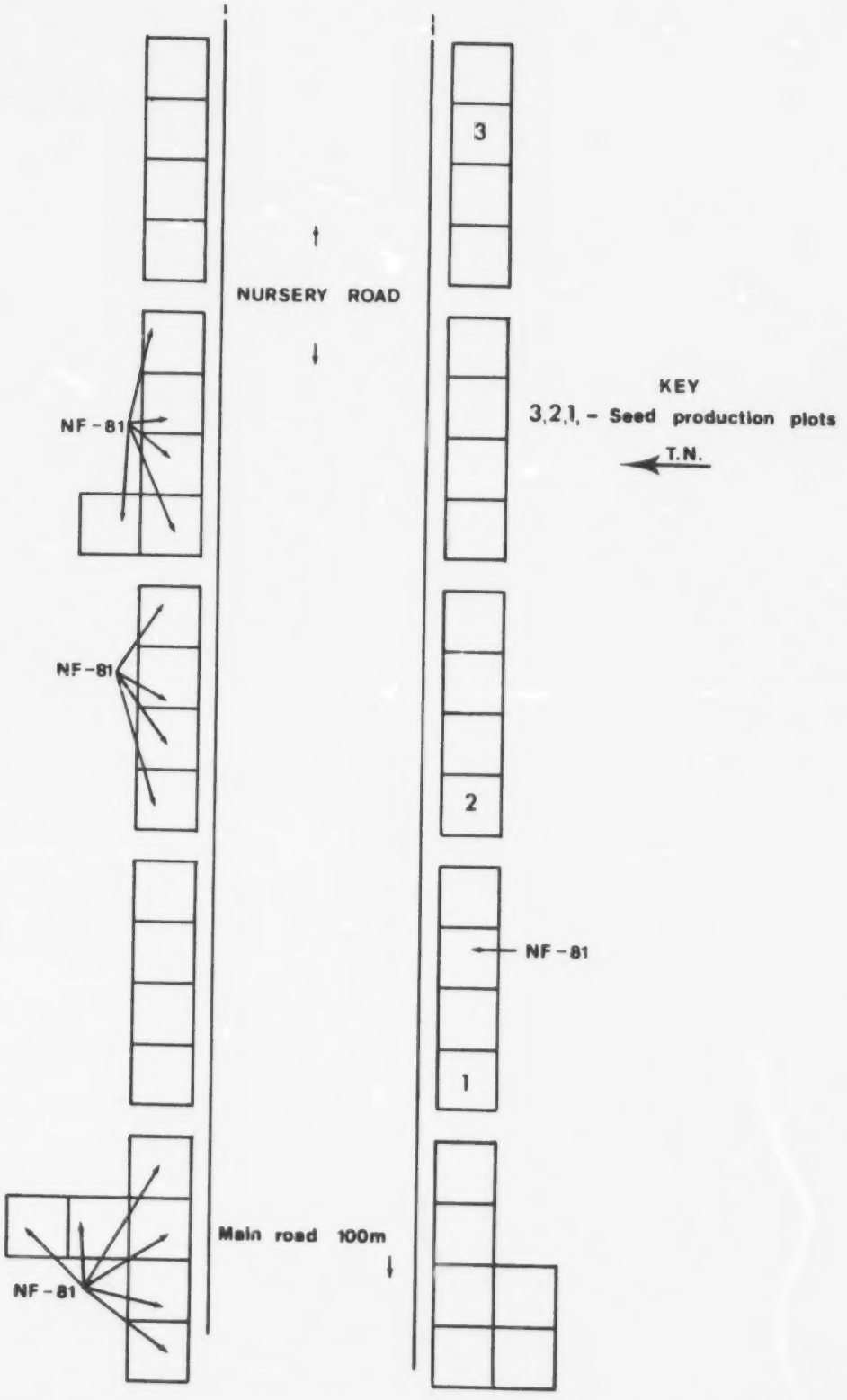
Since 1977 many of the hardwoods, especially the alders have sprouted and are now quite dense. However, the objective of removing the competition from around the seed producing trees was achieved and the spruce are now free of competition from other species on the site.



DEMONSTRATION SEED PRODUCTION AREAS
LOCATION

DEMONSTRATION SEED PRODUCTION AREAS

LAYOUT



DEMONSTRATION SEED PRODUCTION AREAS

Thinned, cleaned, natural black spruce in Site 3, February 1979. Note cones on tree on right.

DEMONSTRATION SEED PRODUCTION AREAS

Results

Seed yields from seed production areas:

Year collected	Site	Avg. wt. of cones[1]	Wt. of 1000 seeds	Total seed per cone	Full seed per cone	Percent germination[2]	Germinative capacity[3]
1978	1	1.22	1.62	10.2	3.5	34.7	78.0
	2	1.01	0.78	4.2	0.9	26.0	74.0
	3	1.73	2.36	13.5	7.8	57.6	95.9
1979	1	1.36	0.93	6.8	3.7	54.6	98.9
	2	0.94	0.95	5.5	2.6	48.1	100.0
	3	1.10	1.11	9.5	1.9	19.6	99.7
1980	1	1.38	0.81	31.2	6.9	17.3	78.8
	2	1.22	0.90	22.2	8.9	35.2	87.2
	3	1.58	1.18	24.0	9.1	31.8	83.8
1982[4]	1	2.43	1.26	47.3	44.2	59.8	64.0
	2	2.01	1.13	56.2	44.5	58.6	74.0
	3	2.57	1.34	43.6	22.1	43.2	85.2

[1]Weight in grams.

[2]Percent of seed which germinate.

[3]Percent of filled seed which germinate.

[4]No cones collected in 1981.

DEMONSTRATION SEED PRODUCTION AREAS

Assessment of Results

Seed quantity (number per cone) and seed quality (filled seed per cone, germination and germinative capacity) varied widely with site. Site 3 produced the highest seed quantity consistently over the three years. Seed quality, however, varied from site to site over the three years.

Germinative capacity, a common measure of seed quality, was best in 1979 and lowest in 1982 even though 1982 produced the most seed of the three years.

Seed weight, often a quality indicator are highest on site 3, the best quality site. The seed weights on all sites are comparable with other Newfoundland black spruce seed which averages about 1.42 g for 1000 seeds.

Another value of establishing SPA is the availability of the sites for experimental use. Two studies have been established in these SPA and (a) on artificial induction of flowering and one (b) to study inbreeding effects in black spruce.

(a) It was found that trees could be induced to flower by the application of exogenous growth substances, gibberellin ($GA_{4/9}$) and an auxin (NAA). Both female and male flowering was greatly enhanced following foliar application of these substances in early July.

(b) Twelve mother trees in the SPA were pollinated with pollen from various distances from 22 000 m to 0 m. Self-pollination (0 m) resulted in a decrease in seed set and early seedling growth, indicating that selfing was deleterious and that measures to avoid it must be included in seed orchard management of the species.

Reports and Publications

Hall, J. Peter. 1983 (in press). Genetic improvement of black spruce. In Proceedings of the nineteenth meeting of the Canadian Tree Improvement Association, Part 1, Env. Can., Can. Forest. Ser., Ottawa.

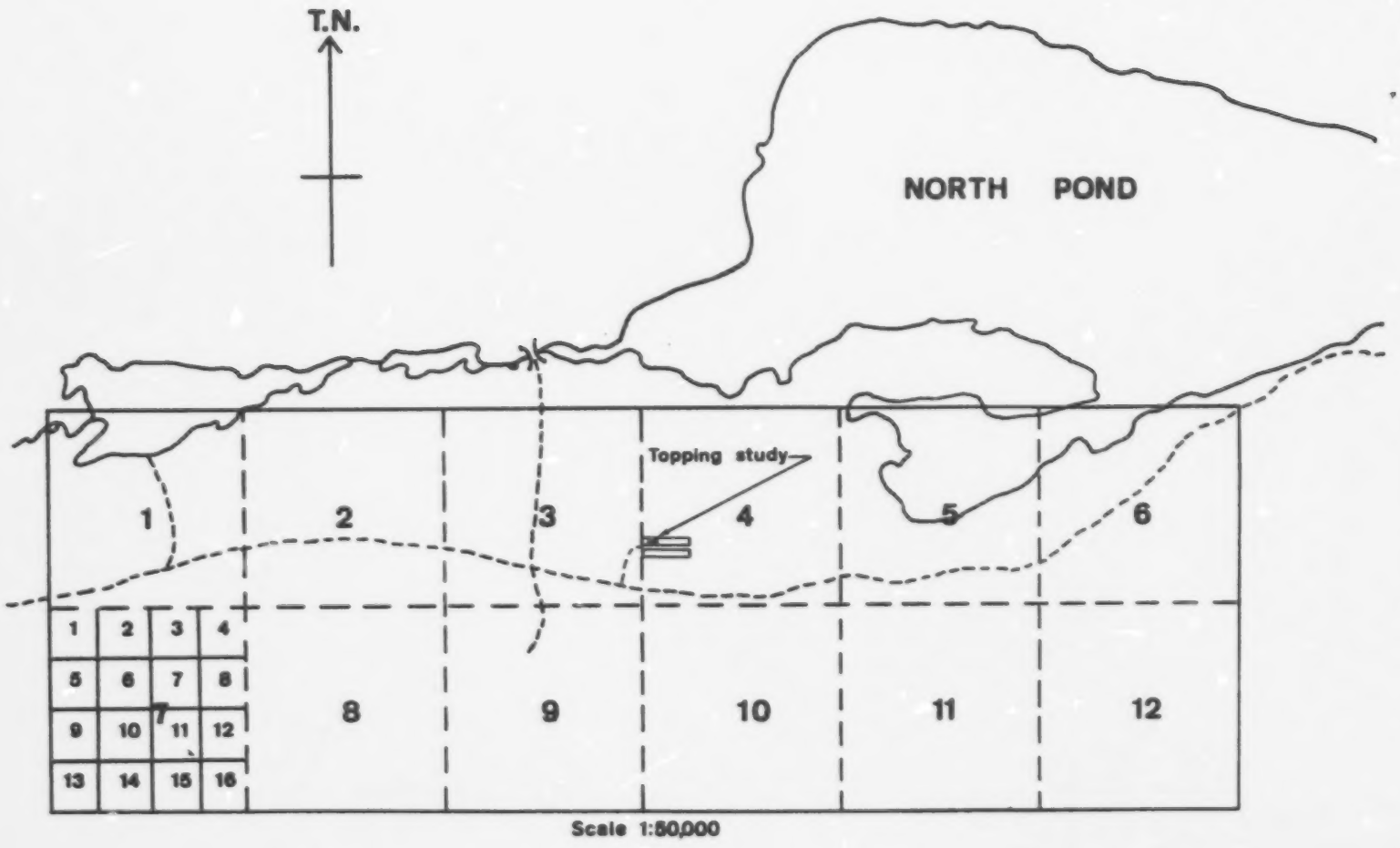
TOPPING STUDY ON BLACK SPRUCE

This study evaluates the effect on seed and cone production of crown topping on 15-20 year old black spruce. This procedure is being examined as a means of retarding height growth to reduce the cost of seed collection. If the flowering zone is kept nearer the ground it reduces problems with flowering studies, controlled pollination and evaluation of the seed crop. The treatment may also stimulate increased branching which provides a larger crown surface for increased flower and cone production.

Site. The site formerly supported a mixed stand of balsam fir and black spruce prior to clearcutting in 1957. In 1961 the area was burned by wildfire and subsequently regenerated to black spruce, white birch, trembling aspen, pin cherry and alder. The site is on an easterly slope with strong till soils with a clay loam texture. Drainage is moderately good with occasional wet patches dominated by alder. Occasional unforested patches covered with Kalmia are also present. Site Type 5 (p. 9).

Design. Study trees were selected randomly in one part of the seed production area.

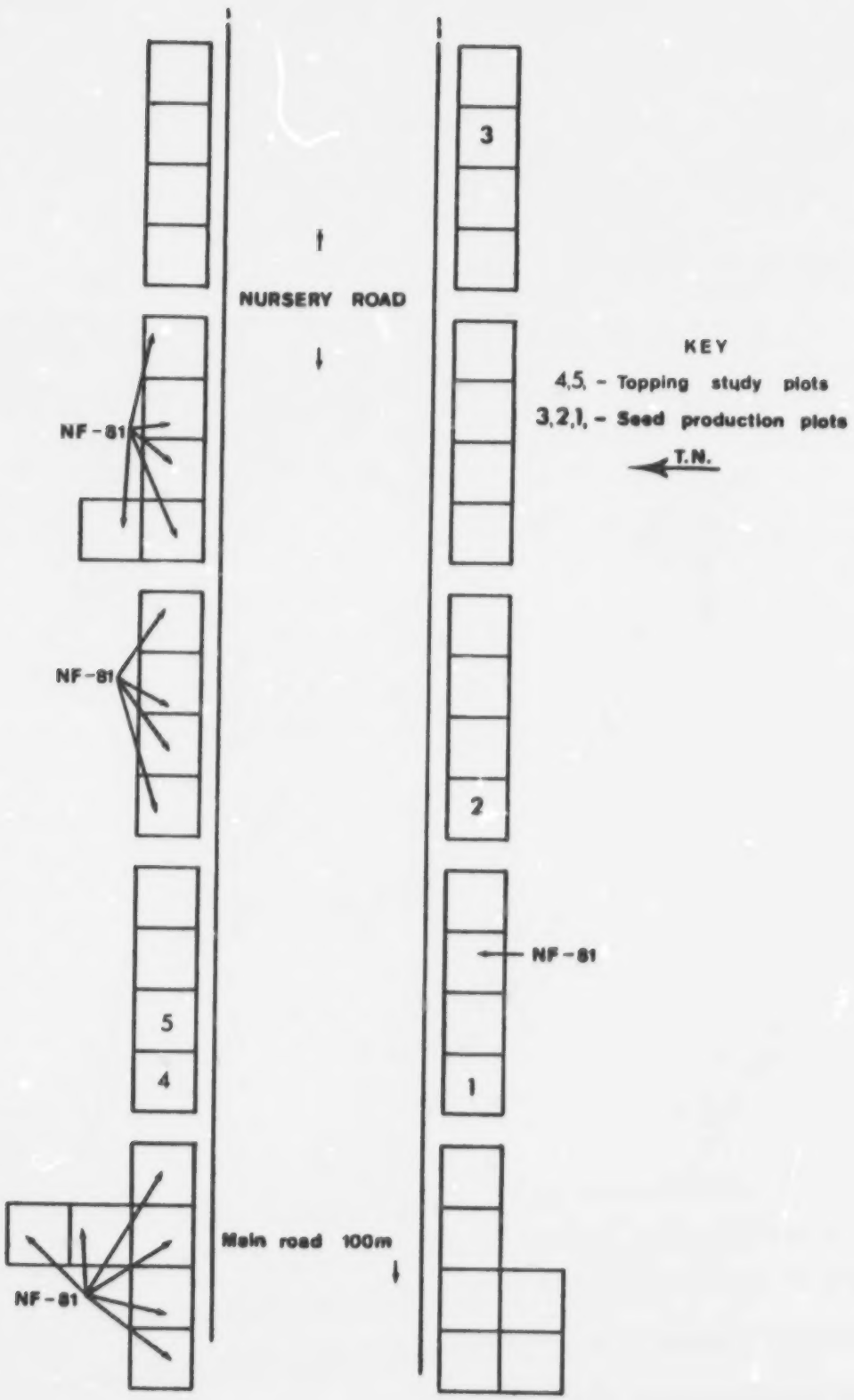
History. The trees for the study were selected in 1978, a fairly poor flowering year. Selected trees either had cones in 1978 or had flowered previously and all were large enough to flower, being over 2.5 m tall. Forty-eight trees were selected and divided randomly into four treatments: A - control, B - removal of one year's height growth, c - removal of two years' height growth, and D - removal of three years' height growth. Cones were collected from all flowering trees from 1978 to 1981. The data has been analysed but not previously published. No further treatments were done until October 1981 when vertical stems on the trees in treatments B, C, D were cut back to 1978 levels. Also, in 1981 a further 12 trees were selected and were cut at one-half crown height to assess the effects of more drastic crown topping.



TOPPING STUDY ON BLACK SPRUCE
LOCATION

TOPPING STUDY ON BLACK SPRUCE

LAYOUT



Results

Production of cones and seed quality - topping study.

Treatment	Year	% of trees with cones	No. of cones per tree	Avg. cone weight g	Total seed per cone	Weight of 1000 seed	% Germination	Germinative capacity
A - control	1978	33.3	11.0	1.24	8.1	1.15	48.2	81.9
B - 1		41.7	13.8	1.71	15.4	0.97	56.3	89.8
C - 2		75.0	27.0	1.47	12.4	1.00	42.2	74.1
D - 3		25.0	5.7	1.01	4.8	0.88	24.4	90.8
A - control	1979	83.3	19.8	1.35	26.3	1.07	35.2	98.3
B - 1		16.7	111.0[a]	1.71	23.8	1.05	14.1	99.5
C - 2		8.3	2.0	0.99	0.0	-	-	-
D - 3		0.0	-	-	-	-	-	-
A - control	1980	91.7	23.2	1.80	9.1	1.22	68.6	98.3
B - 1		50.0	20.0	1.76	19.2	1.18	52.7	98.5
C - 2		41.7	9.4	1.40	13.8	1.01	47.0	98.4
D - 3		25.0	18.7	1.40	13.8	1.71	45.1	98.9
A - control	1981	33.3	3.5	1.31	10.2	0.89	0.0	-
B - 1		25.0	21.0	1.23	5.1	0.87	0.0	-
C - 2		16.7	3.0	.96	3.0	0.90	0.0	-
D - 3		8.3	5.0	1.06	4.8	0.79	0.0	-
A - control	1982	100.0	95.6	1.88	33.4	1.19	66.7	95.0
B - 1		0.0	0.0	-	-	-	-	-
C - 2		0.0	0.0	-	-	-	-	-
D - 3		0.0	0.0	-	-	-	-	-

[a]Two hundred nineteen cones were on one tree.

TOPPING STUDY ON BLACK SPRUCE

Assessment of Results

Average total height of the trees in 1978 was as follows:

Treatment	Avg. ht. before	and after treatment
A	3.3	3.3
B	3.4	2.6
C	3.6	2.4
D	3.3	1.9

Thus the average height of the potential cone producers in the shortest group was over a third less than the controls.

The 1978 data also show an unequal distribution among treatments of degree of cone and seed production and of total amount of seed and of quality of seed produced. The D treatment is particularly deficient in numbers of cones, seeds and percentage germination.

The first year after treatment showed a distinct lowering in quantity of cones and quality of seed produced. In 1980 there was considerable recovery in numbers of cones produced on the treated trees but numbers of cones were still below the controls. Numbers of seed on the treated trees exceeded that on the controls, but the percentage germination declined slightly. Even with the decline in germination percentage the percent of filled seed per cone on the treated trees exceeds or equals that of the controls because of the greater total yield of seed. The final year, 1981, was a very poor year for flowering with the fewest cones of the four years. This resulted in a much lower yield on the controls and nearly all of the seeds were empty. The empty seed can be attributed to an almost complete lack of pollen in the area in 1981.

The results, although preliminary, indicate that the flowering zone in young black spruce trees can be maintained at low levels without loss of seed-producing capacity in normal crop years.

In 1982 seed was produced on control trees only because the flowering zones were removed when the trees were cut back to 1978 levels.

D. STAND TENDING

ALDER CONTROL STUDY

A comparison of mechanical brushcutting and several herbicide treatments as methods of releasing an artificially-seeded softwood stand from vigorously competing alders and other hardwoods.

Site. Original black spruce stand was burned by wildfire in 1941, then salvage-cut for pulpwood in late 1940's. Area was burned again by wildfire in 1961 which destroyed natural regeneration and left the fresh to moist very stony till soil almost without organic covering. Gentle north slope. Alders and other hardwoods have aggressively colonized the site since 1961 fire, competing intensely with stand of black spruce and jack pine artificially seeded in 1965 (see NF-84 - Aerial seeding) and in many cases suppressing it. Site Type 4 (p. 6).

Design. Randomized complete block with four replications of each of five treatments:

a) Early 2,4-D - 1.1 kg a.e./ha applied by mistblower in early July,

b) Late 2,4-D - 1.1 kg a.e./ha applied by mistblower in early August,

c) Tordon pellets - 40 kg/ha spread by hand,

d) Brushcutting all hardwoods using brushsaws and axes,

e) Control

Treatment plots, separated by cut lines, are each 0.2 ha (50 m x 40 m) - total area 4 ha.

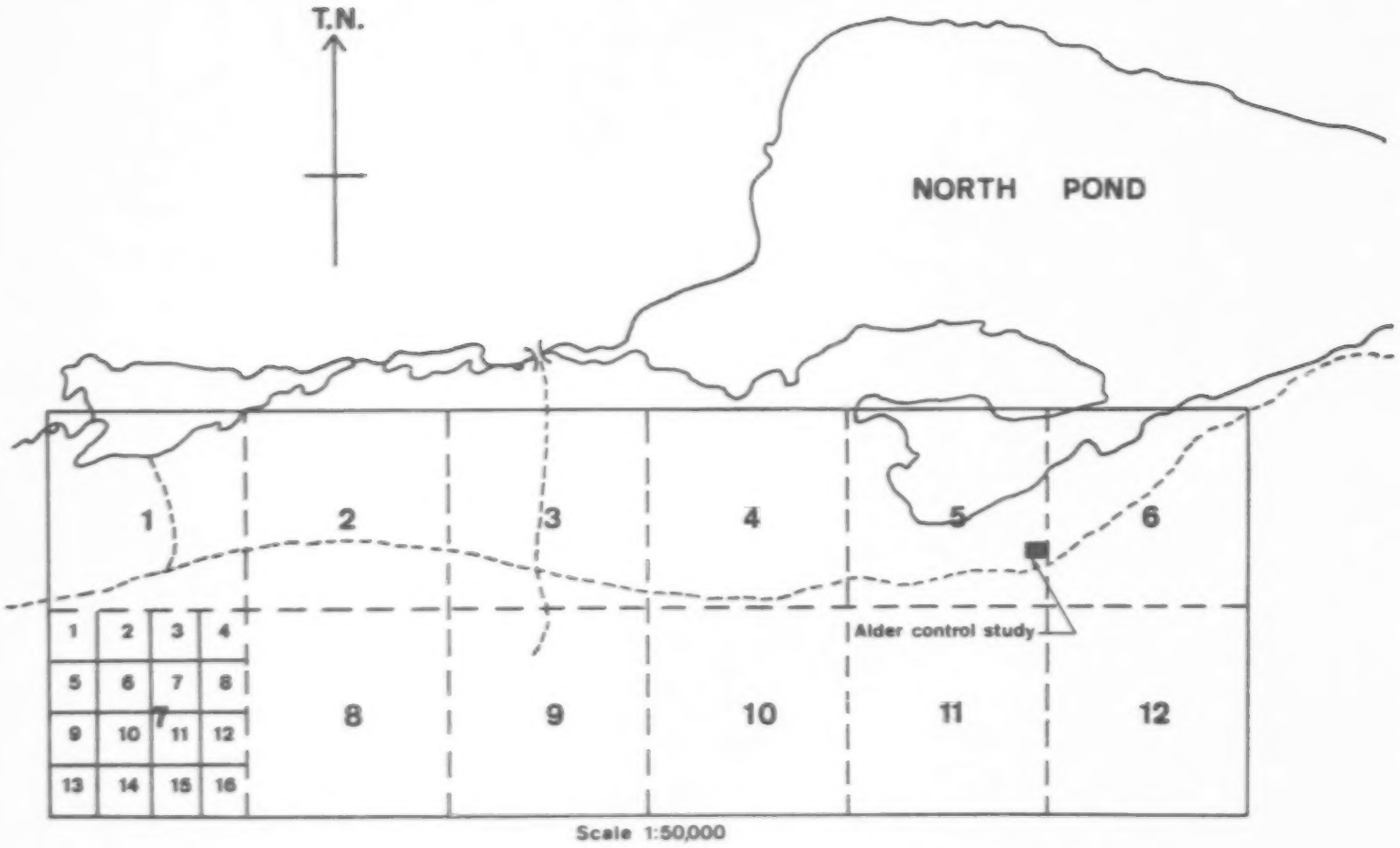
Measurements made on two permanent sub-plots each 100 m^2 (10 x 10 m) in each plot.

History. Plot layout and pre-treatment survey of regeneration and hardwoods spring 1975.

Treatments applied in 1975.

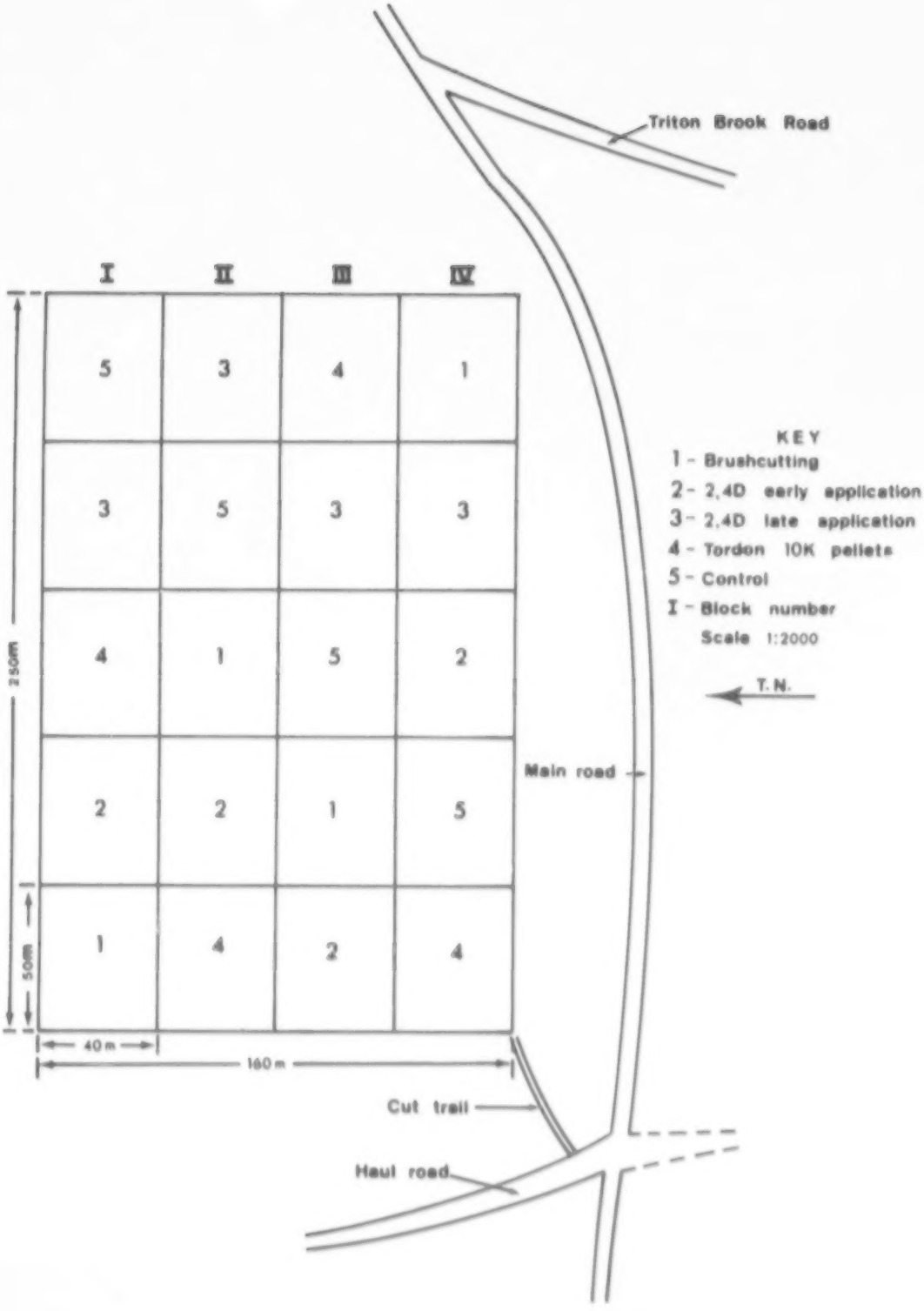
Sub-plots examined May 1976 for treatment damage to softwoods, August 1976 for effects of treatments on hardwoods, September 1977 and 1979 for softwood and hardwood survival and growth.

Boundary lines and post re-established, summer 1983.



ALDER CONTROL STUDY
LOCATION

ALDER CONTROL STUDY
LAYOUT



Applying 2,4-D herbicide by mistblower, July 1975.

Release growth on black spruce seedlings in Tordon-treated plots, September 1979, four growing seasons after treatment.

ALDER CONTROL STUDY

Results

Treatment effects on softwoods - before and after:

Treatment	Stem density (stems/ha)			Av. ht. tallest stem/quad.(cm)			Av. leader tallest stem/quad.(cm)		
	Jun 75*	Sep 77	Sep 79	Jun 75*	Sep 77	Sep 79	Jun 75*	Sep 77	Sep 79
Black spruce									
Brushcutting	18 300	12 800	12 400	135	157	187	14	13	16
Early 2,4-D	20 100	15 900	14 800	114	153	184	14	19	17
Late 2,4-D	16 200	18 600	15 800	118	154	187	15	17	16
Tordon	17 100	10 100	9 000	103	106	132	13	12	17
Control	23 400	18 700	16 300	137	176	205	17	19	16
Jack pine									
Brushcutting	1 800	1 200	1 100	141	194	244	23	21	36
Early 2,4-D	3 400	2 600	2 500	154	204	262	25	25	34
Late 2,4-D	3 100	2 900	2 400	90	113	161	19	14	25
Tordon	3 600	500	400	155	149	181	26	9	30
Control	4 300	2 900	2 200	74	111	164	14	16	25

Treatment effects on hardwoods - before and after:

Treatment	Estimated hardwood cover (%)			Number of live hardwood** stems/ha		
	Jun 75*	Sep 77	Sep 79	Jun 75*	Aug 76	Sep 77***
Brushcutting	71	26	35	56 500	53 600	70 700
Early 2,4-D	68	31	41	65 000	31 900	41 100
Late 2,4-D	64	29	47	59 300	34 600	49 700
Tordon	72	14	32	72 000	9 800	19 800
Control	72	49	60	68 200	50 500	53 600

*Before treatment.
**On average, 70 percent of stems were alders.
***Includes 'old' stems + 'new' ones originating after treatment.

ALDER CONTROL STUDY

Assessment of Results

Tordon gave the best control of alders and other hardwoods, but caused considerable softwood mortality, particularly of jack pine.

Early July application of 2,4-D gave reasonable control of hardwoods with minimal damage to softwoods.

Early August application of 2,4-D caused somewhat less softwood damage than July application, but did not control the hardwoods as well.

Brushcutting stimulated an intense regrowth of hardwoods, and, though it did release the softwoods at least temporarily, caused appreciable mechanical damage to and loss of softwood stems.

All treatments except 2,4-D applied in August resulted in increased softwood leader growth by 1979. This release growth was most evident where the competing hardwoods were more than twice as tall as the softwoods before treatment.

Reports and Publications

Richardson, J. 1976. Establishment of a test of methods for releasing softwood regeneration from overtopping alders. Environ. Can., Can. Forest. Serv., Nfld. Forest Res. Centre, File Report. 12 p.

Richardson, J. 1979. Releasing softwood regeneration from overtopping alders. Environ. Can., Can. Forest. Serv., Information Report N-X-169. 24 p.

Richardson, J. 1982. Release of young spruce and pine from alder competition. Environ. Can., Can. Forest. Serv., Information Report N-X-211. 13 p.

SPACING TRIAL IN IMMATURE BLACK SPRUCE

This is one of a series of pre-commercial thinning trials being established in dense young softwood stands across the Island, in cooperation with the Nfld. Department of Forest Resources and Lands, and the two pulp and paper companies. The long-term results from these trials will assist in establishing guidelines for optimum thinning regimes to be applied to such stands growing on a variety of sites.

Site and Stand. The previous stand of black spruce and balsam fir was cut for pulpwood in 1957 and subsequently burned by wildfire in 1961. The resulting stand of black spruce contains approximately 14 000 stems/ha, with a mean height of 2.25 m and a maximum height of 5.0 m. Larch and trembling aspen occur as minor species. The trial is located on a moderate north-facing slope, with a moist stony till soil. Heath plants, dominated by Kalmia spp. and Rhododendron spp., are very abundant and, in open areas, form a continuous cover. Site Types 3 and 6 (p. 8-9).

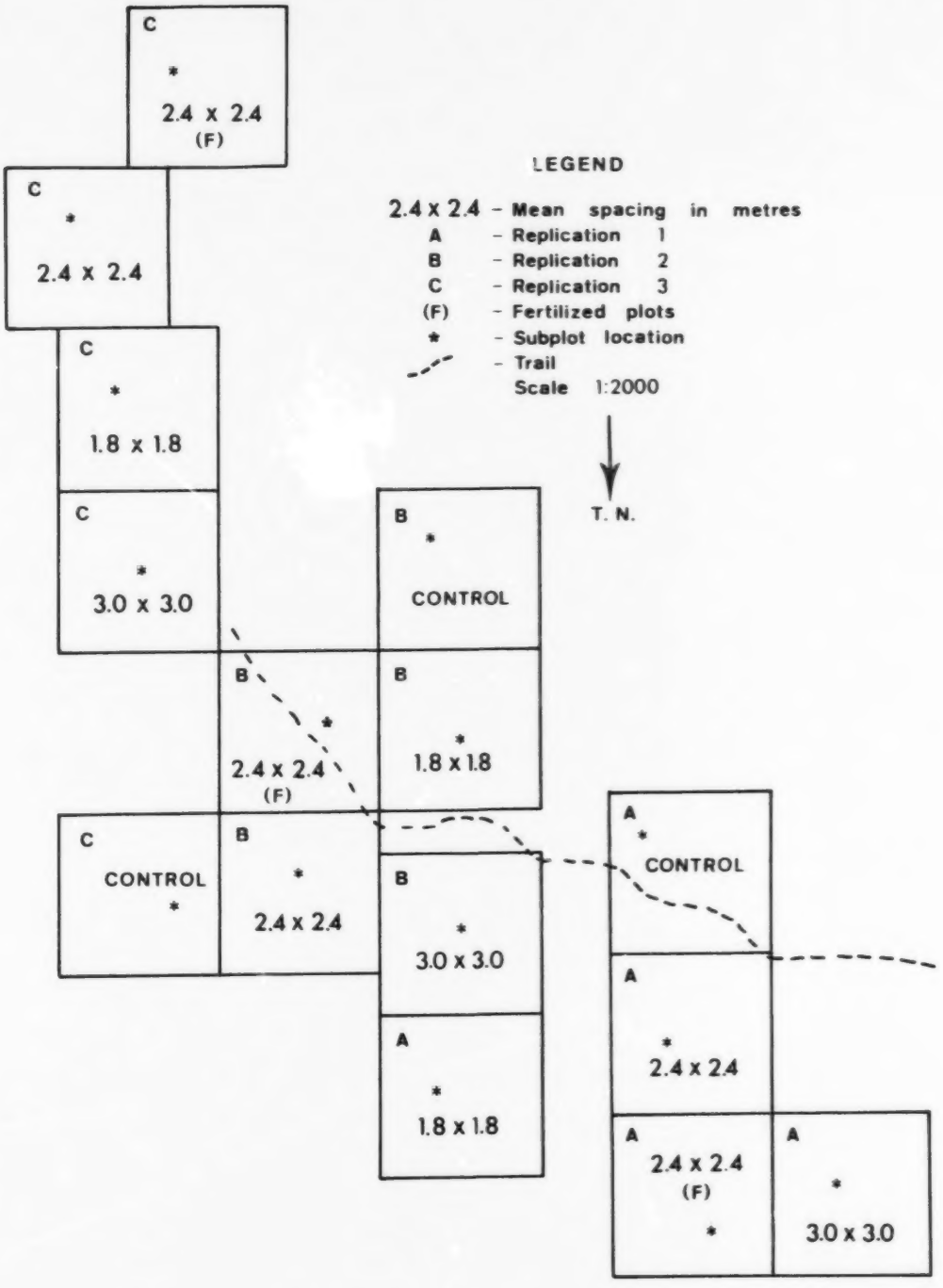
Design. The experiment is a randomized complete block of five treatments replicated three times. Treatments consist of trees thinned to mean spacings of: 1.8 m x 1.8 m; 2.4 m x 2.4 m; 2.4 m x 2.4 m, plus a nitrogen fertilizer; 3.0 m x 3.0 m; and a control. The fertilizer will be applied two years after thinning.

Plots are 50 m square with a circular subplot located within each plot. Sub-plots vary in radii according to the spacing, to provide for approximately 100 leave trees in each.

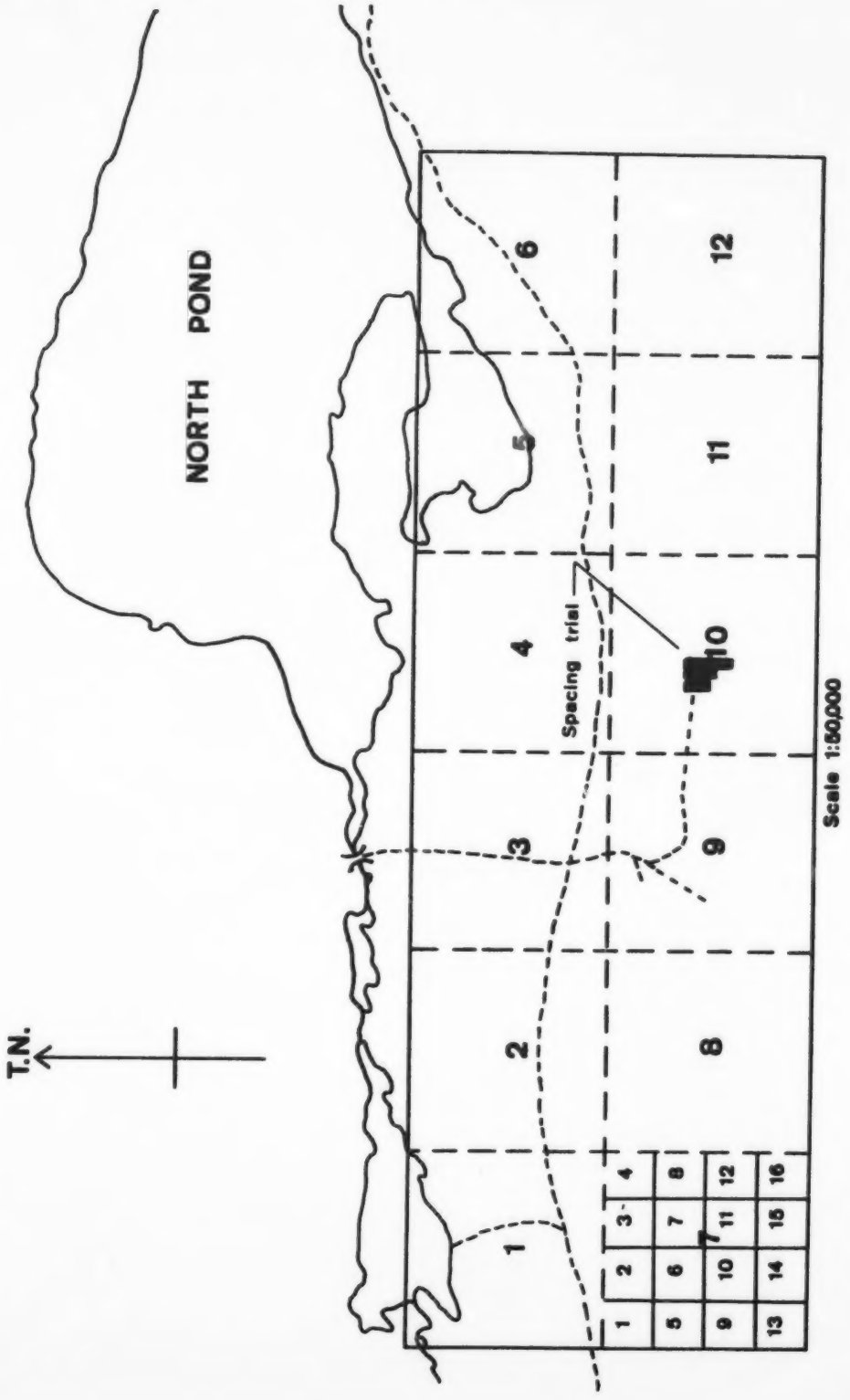
History. Plots were thinned in August 1981. All leave trees in each sub-plot were tagged and their heights and diameters recorded.

SPACING TRIAL IN IMMATURE BLACK SPRUCE

LAYOUT



SPACING TRIAL IN IMMATURE BLACK SPRUCE
LOCATION



SPACING TRIAL IN IMMATURE BLACK SPRUCE

Black spruce stand, prior to spacing showing variation in density and height, July 1981.

SPACING TRIAL IN IMMATURE BLACK SPRUCE

Results

No results are available yet on this trial.